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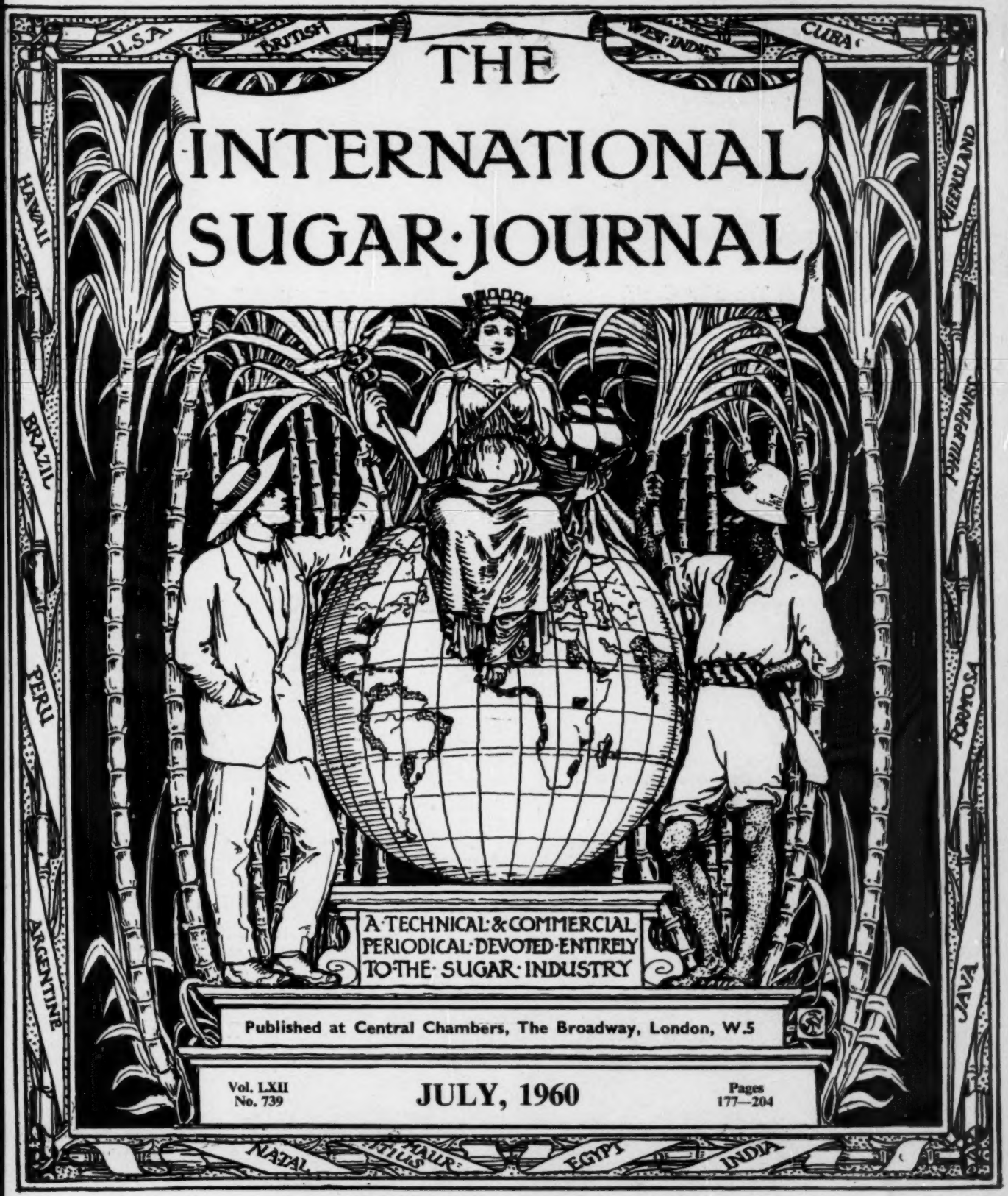

THE INTERNATIONAL SUGAR·JOURNAL

A·TECHNICAL·&·COMMERCIAL PERIODICAL·DEVOTED·ENTIRELY TO·THE·SUGAR·INDUSTRY

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JULY, 1960

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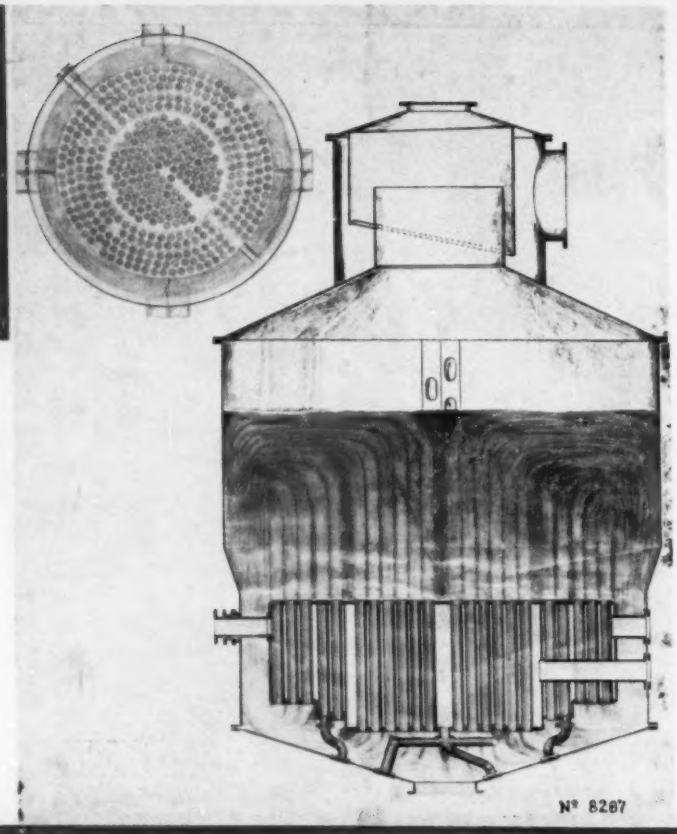

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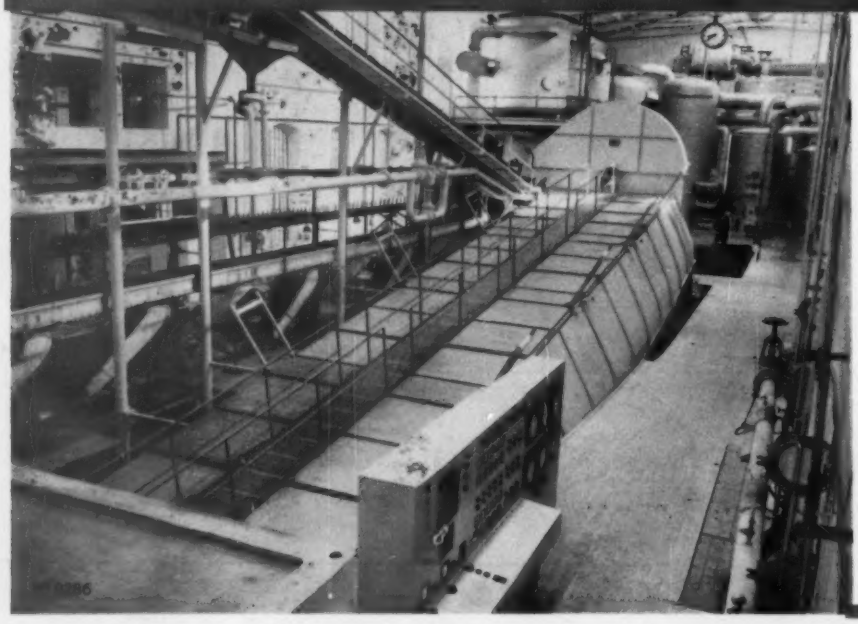

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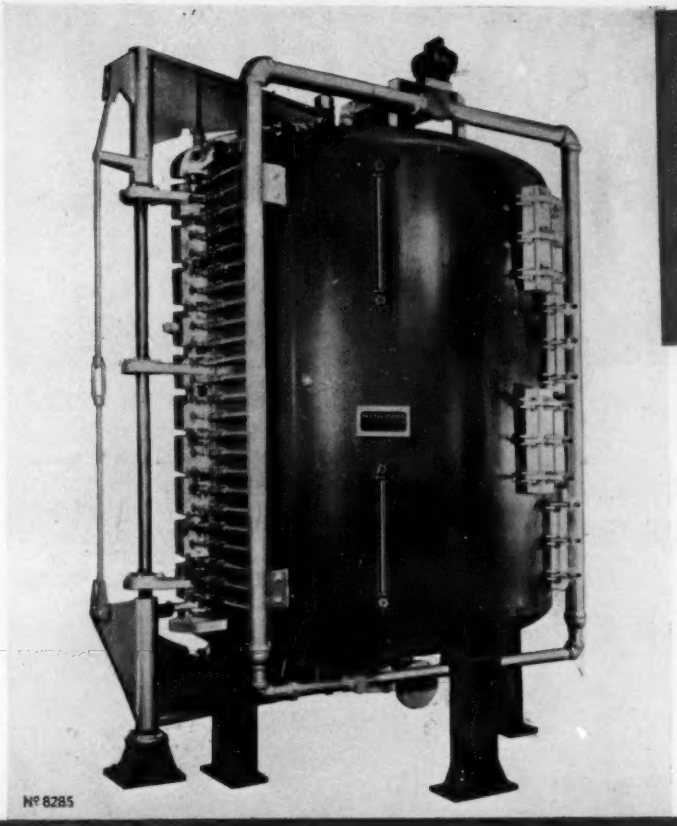

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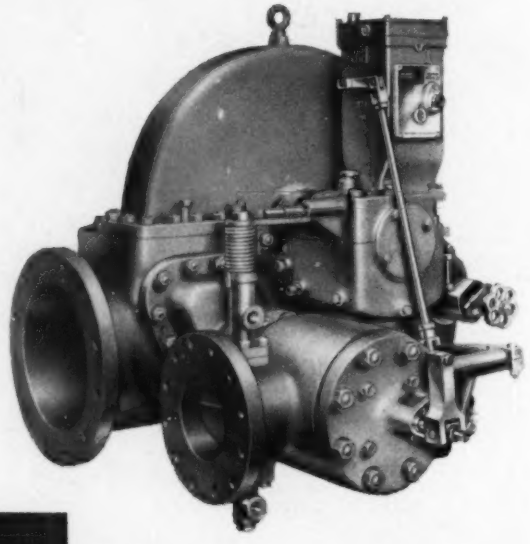

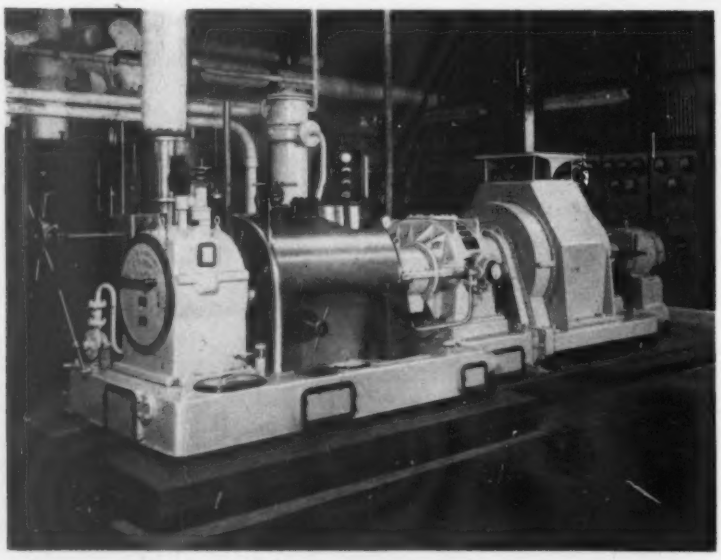

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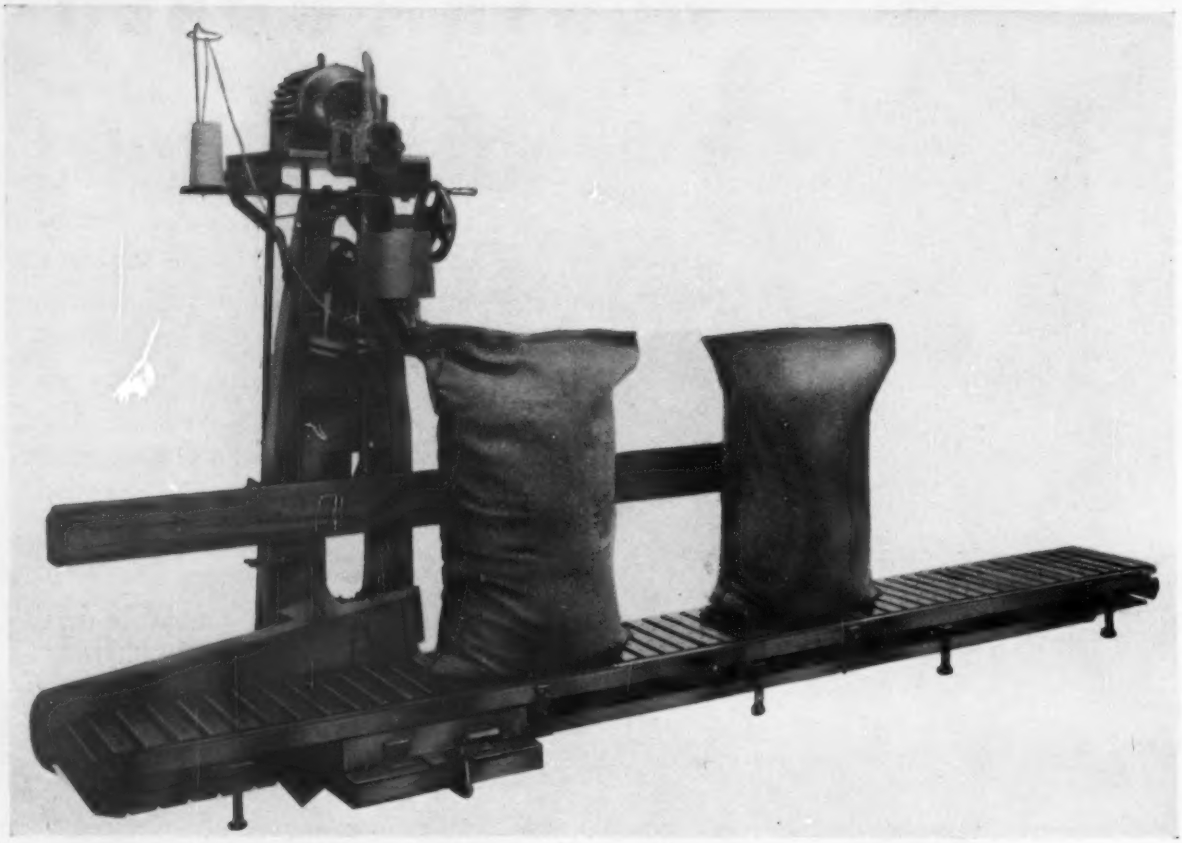

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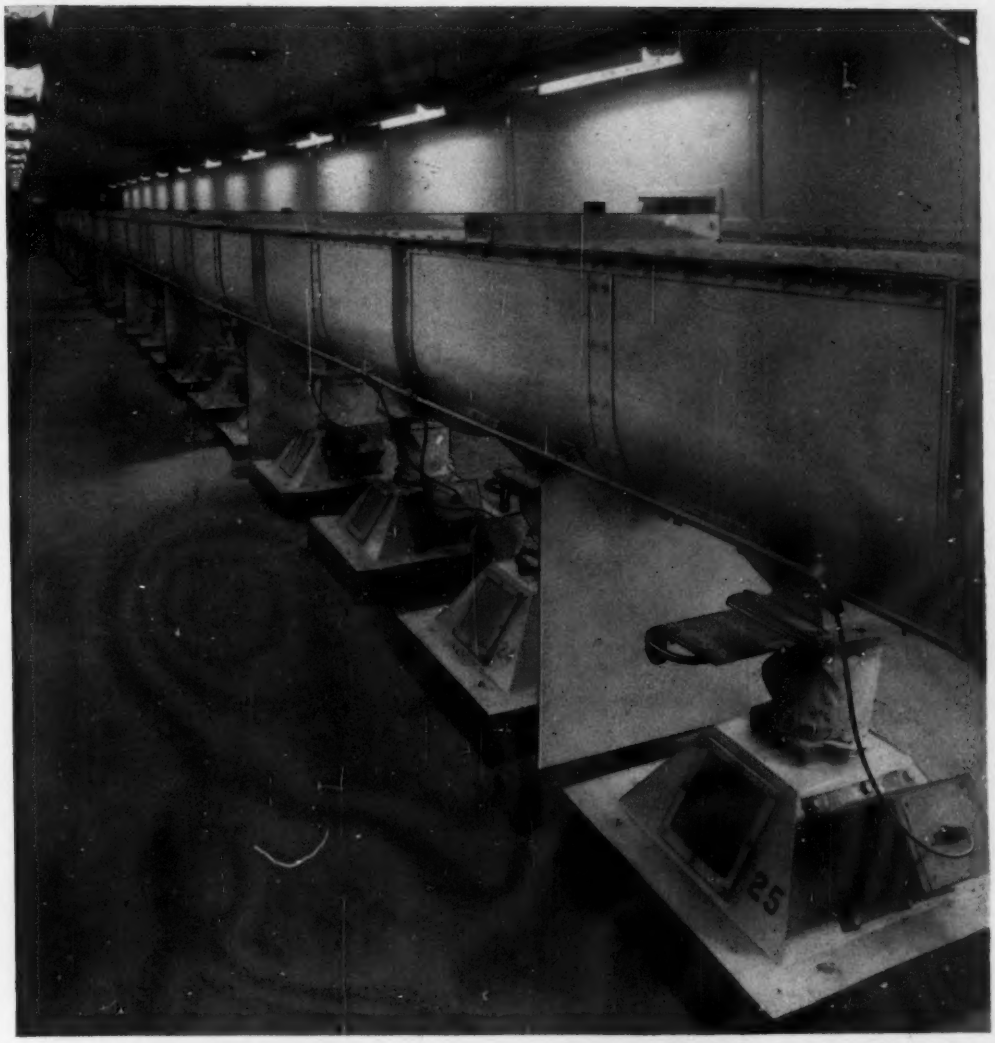

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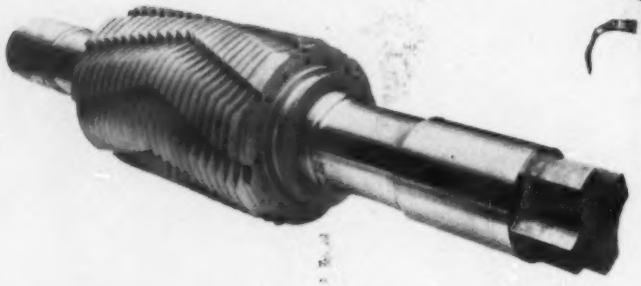

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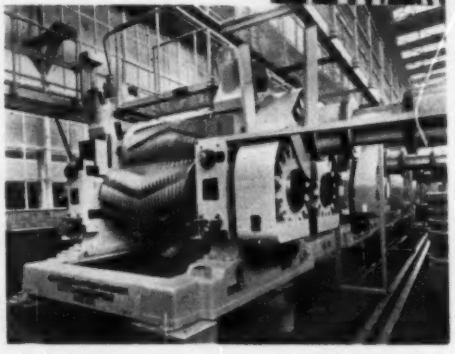

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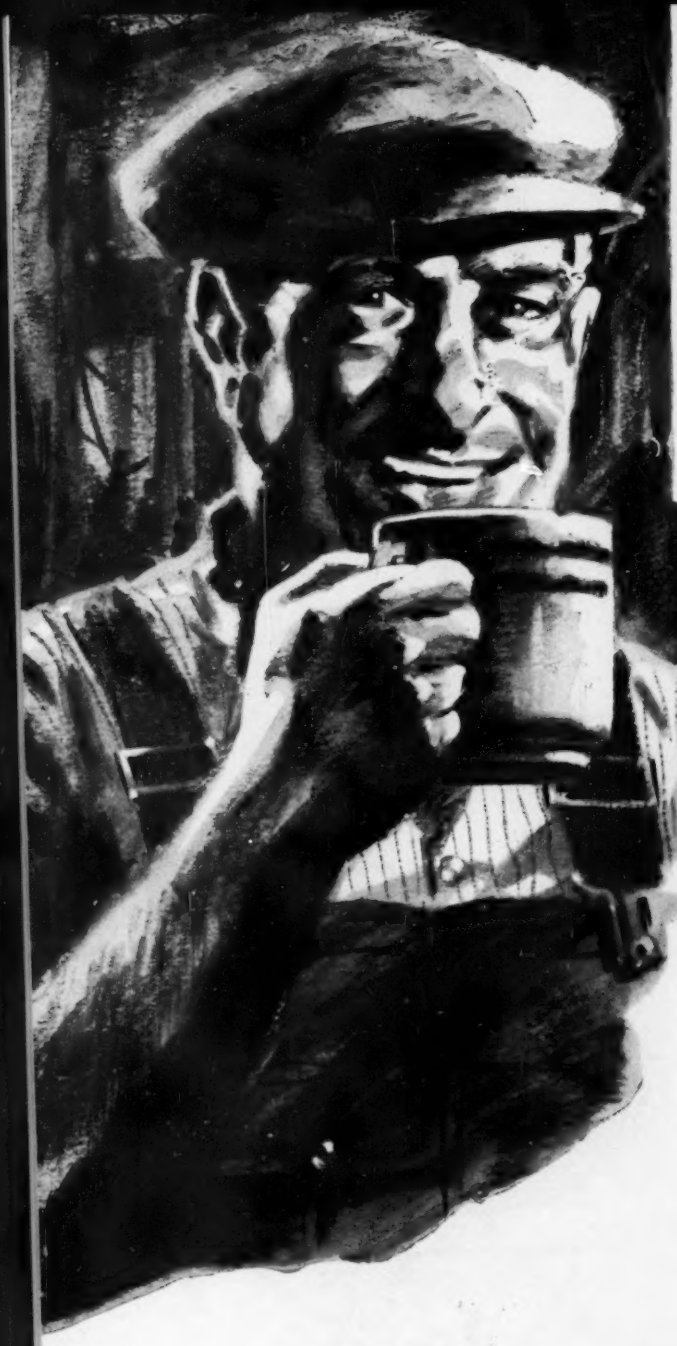
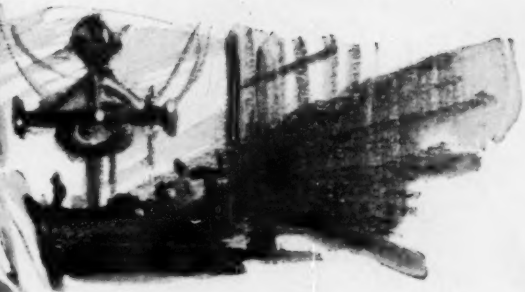


Helping to sweeten it is our cup of tea



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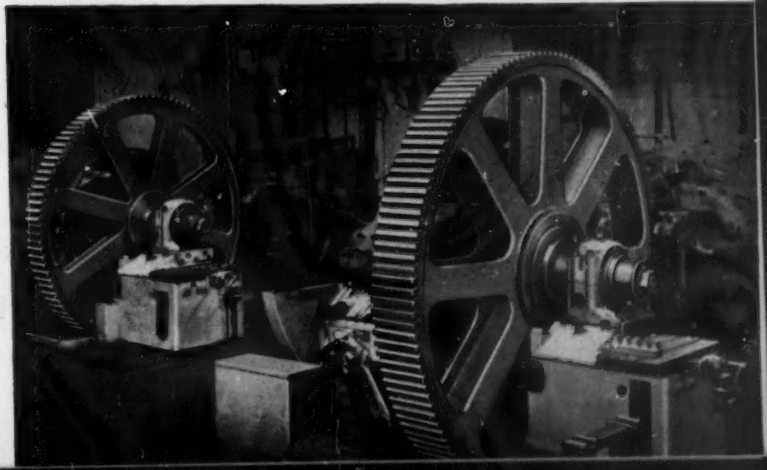

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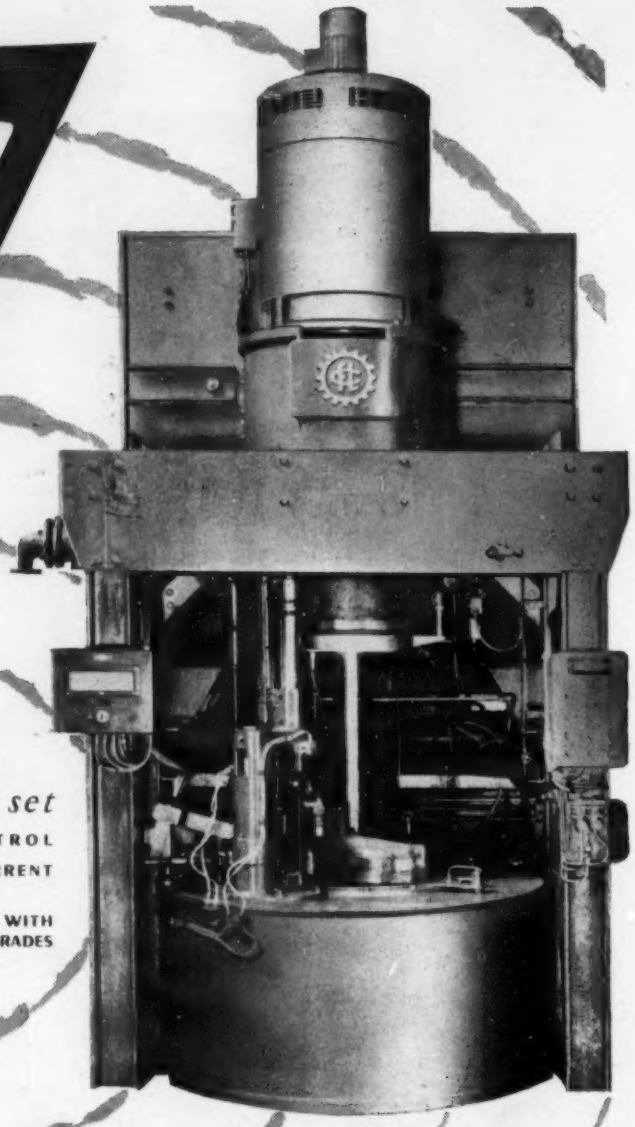

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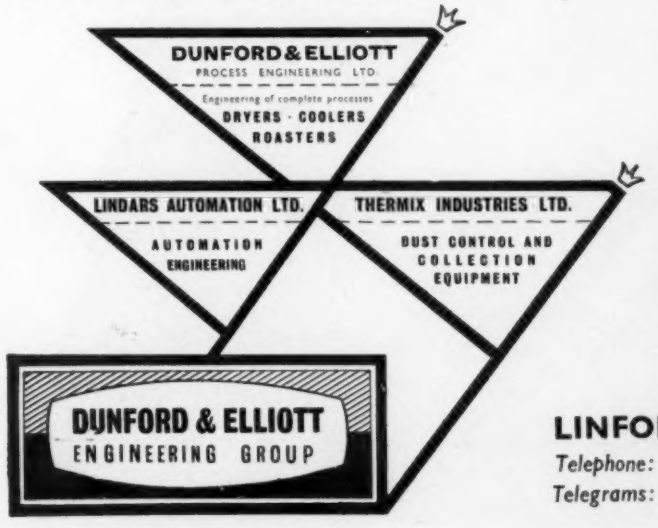

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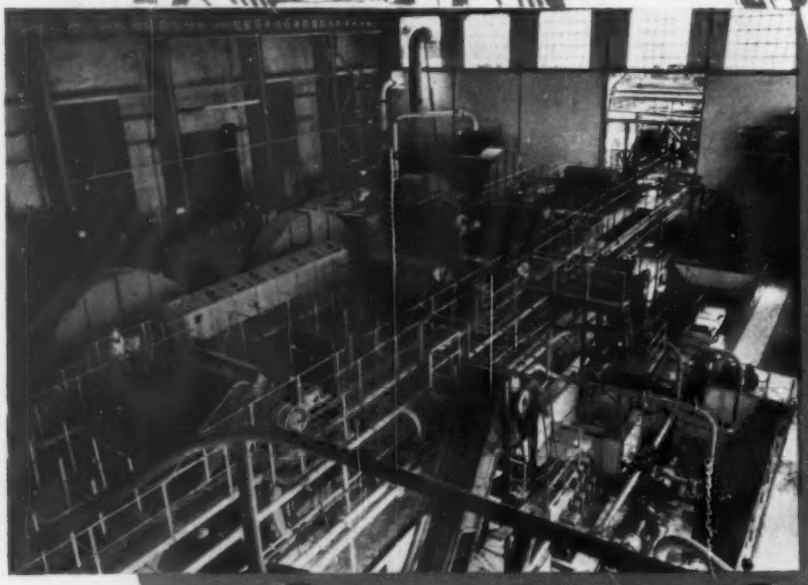

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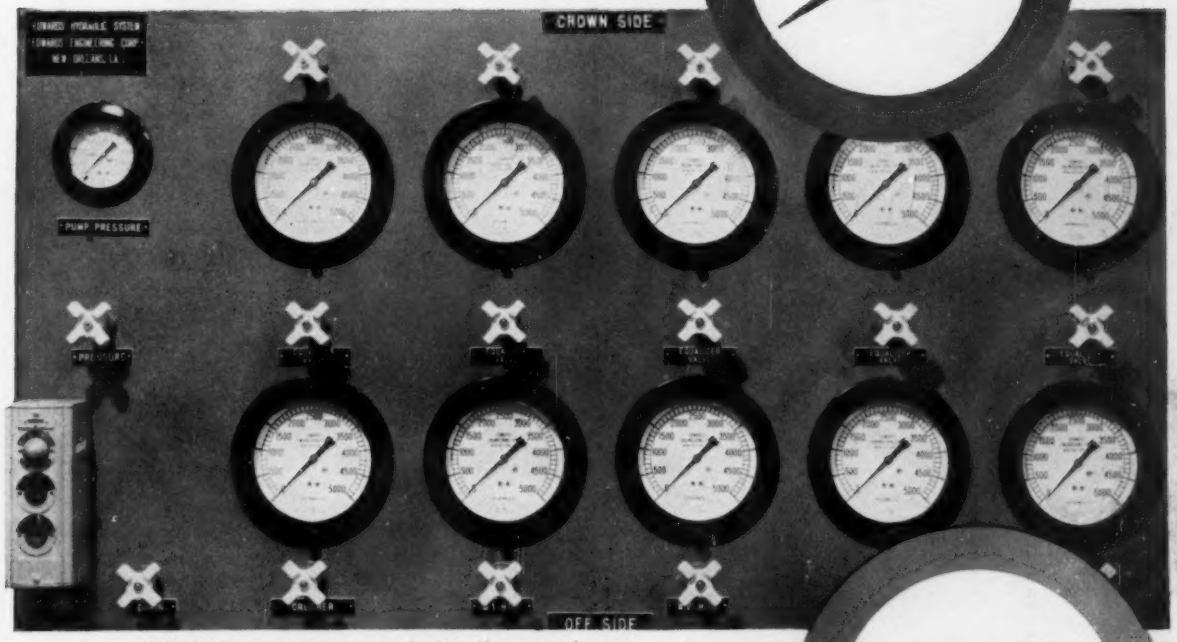

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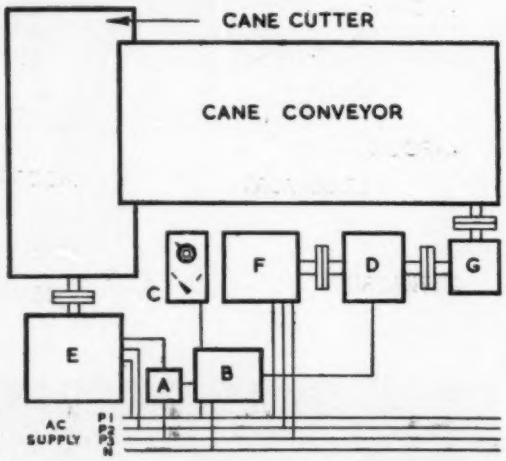

KEY TO DIAGRAM

- **A** Current transformer
- **B** Electronic excitation unit
- **C** Manual control of conveyor speed
- **D** HEENAN-DYNAMATIC COUPLING in conveyor drive
- **E** Cutter motor
- **F** Conveyor motor
- **G** Gearbox

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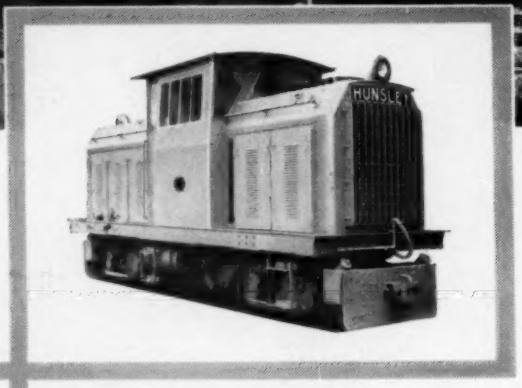

230 *h.p. 'Articulated' diesel locomotive.*

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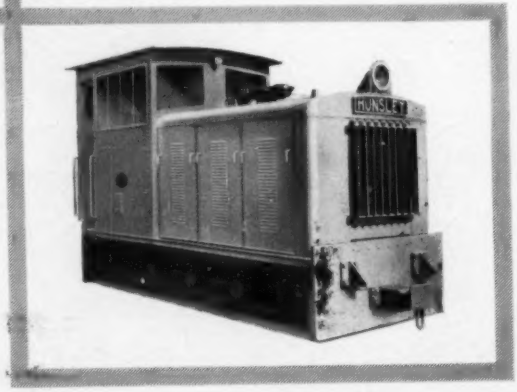

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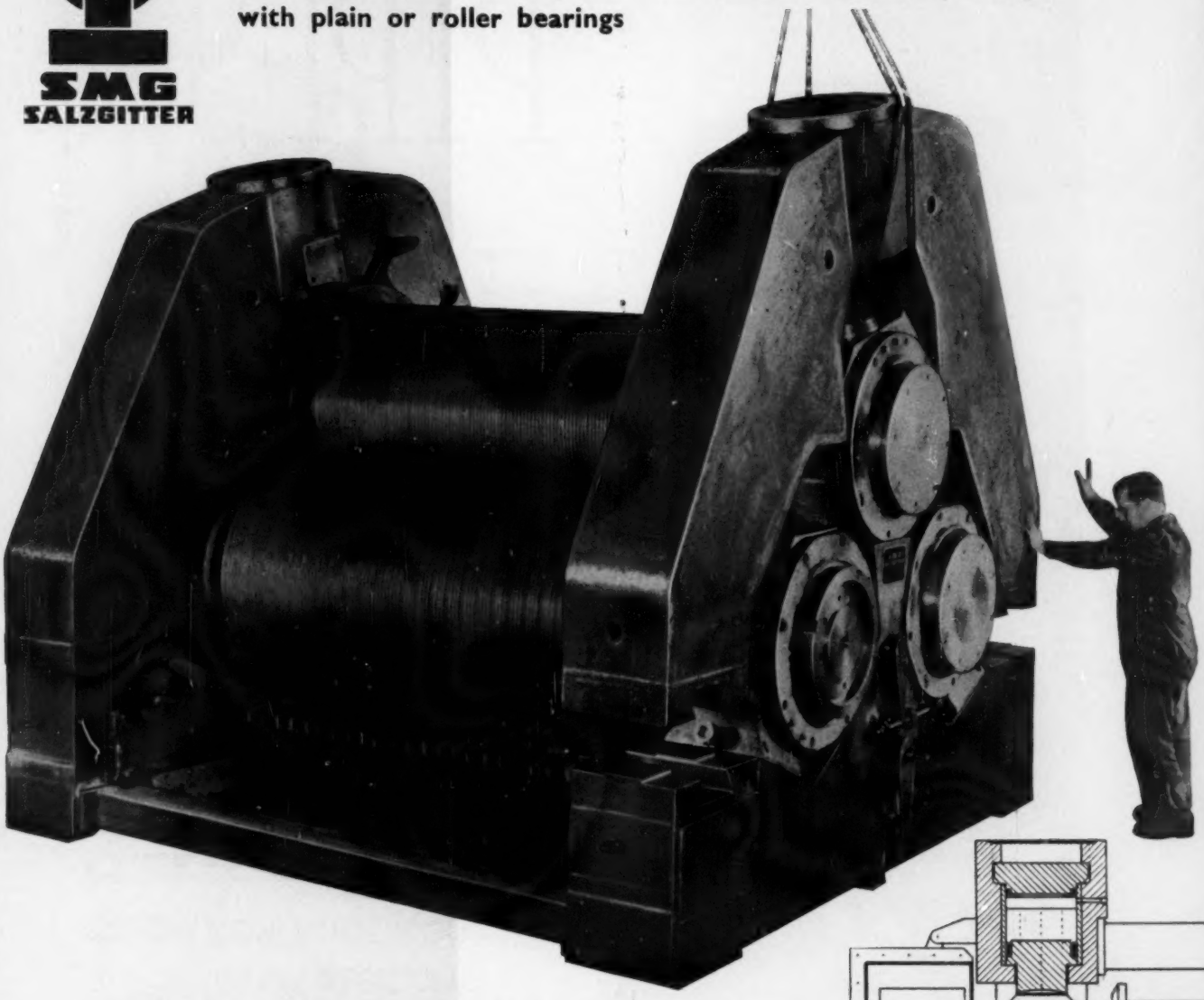

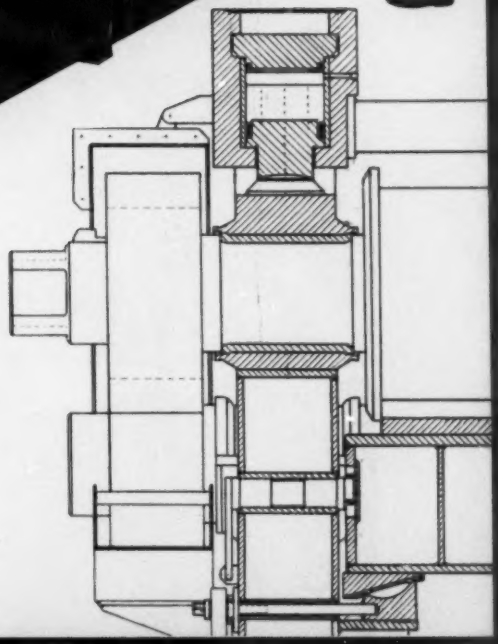

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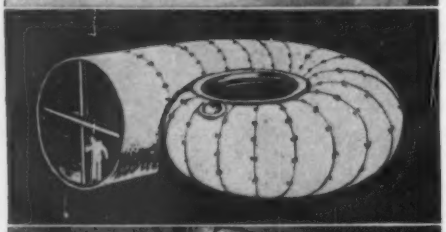

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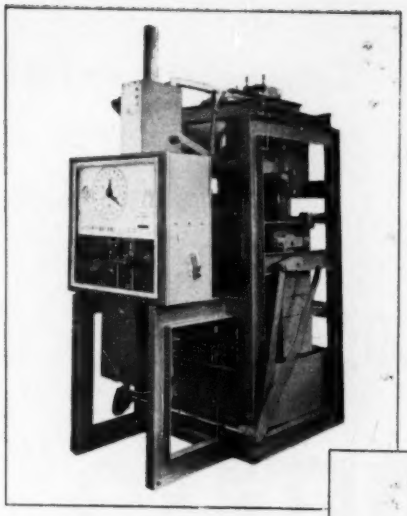
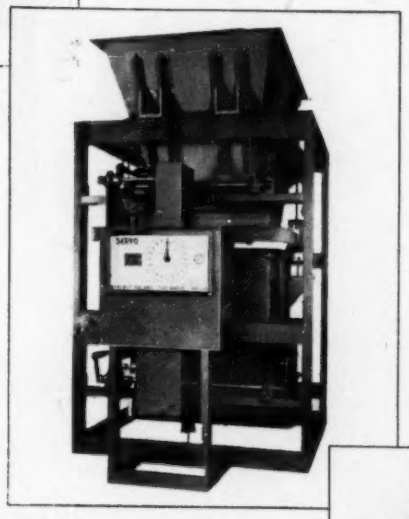


15 t/h molasses



50 /th raw sugar

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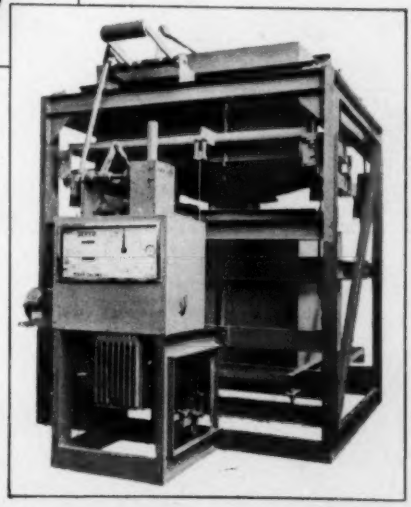

200 t/h sugar juice

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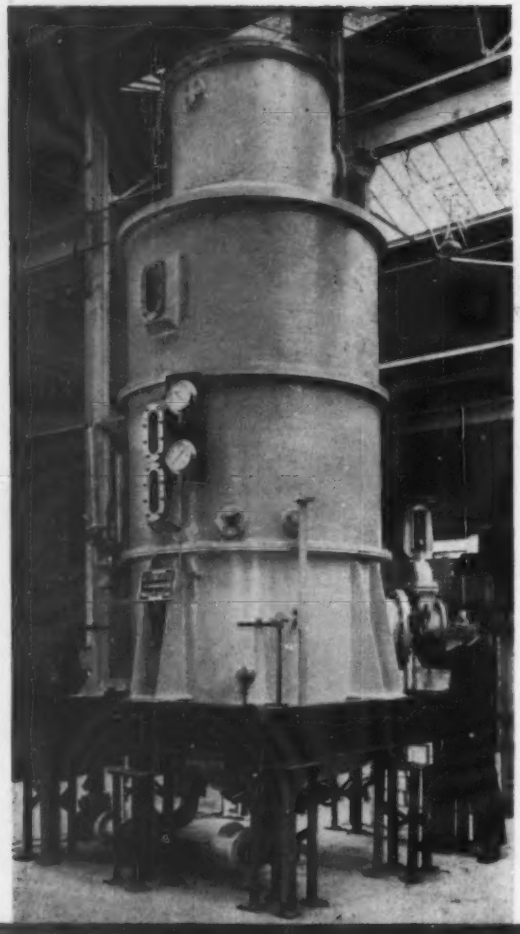
THE HAGUE HOLLAND



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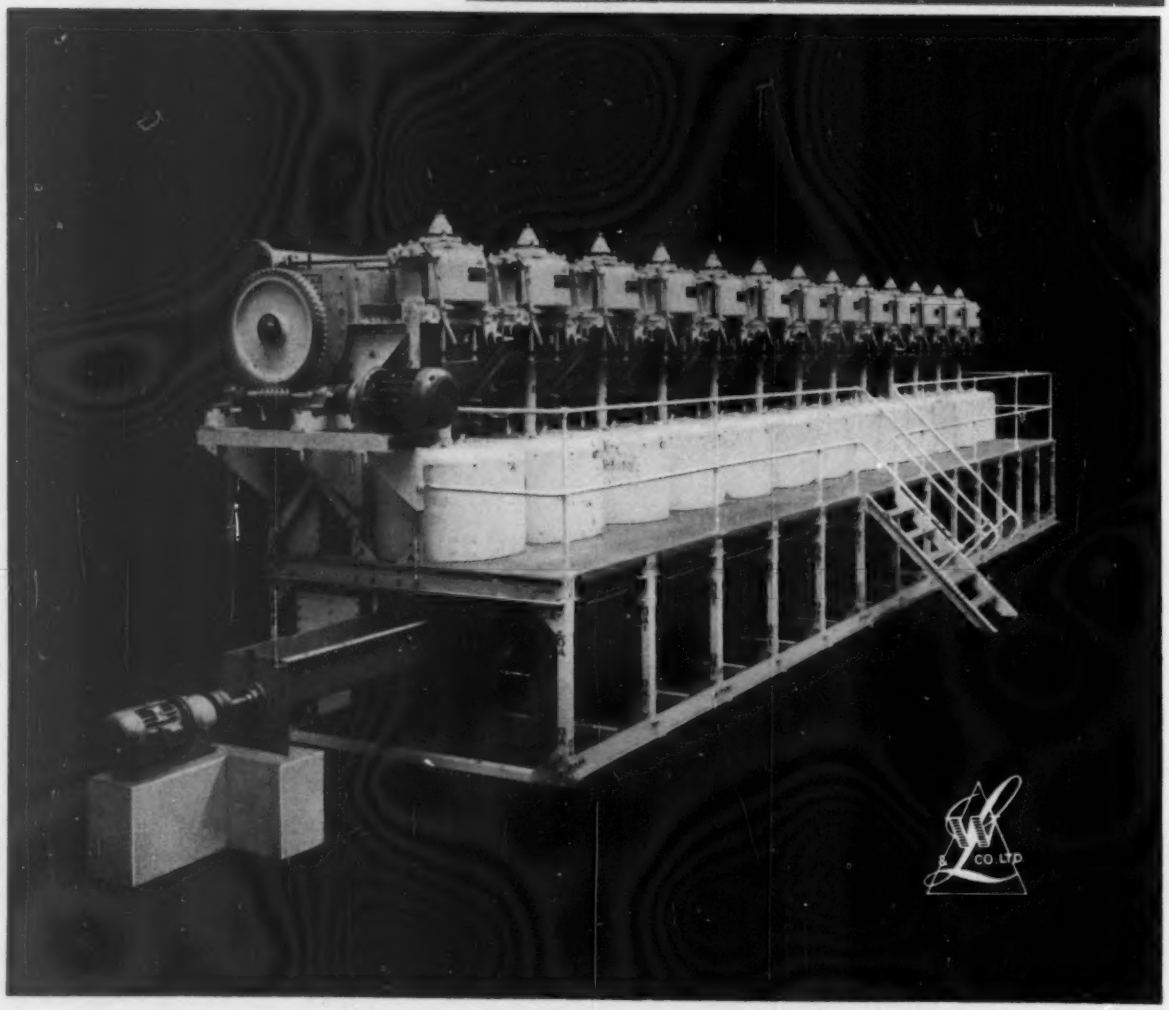


THE
INTERNATIONAL SUGAR JOURNAL

VOL. LXII JULY, 1960 No. 739

NOTES AND COMMENTS

British Sugar Corporation share status.

A reiteration of the facts of the British Sugar Corporation's constitution has been issued recently in the interest of present shareholders and other interested parties and is reprinted below, in somewhat shortened form.

The Corporation is required by Government direction under the Sugar Act, 1956, to purchase, at prices determined by the Ministers, each year's crop of sugar beet, the maximum acreage of which is fixed by the Government. It sells its main product, sugar, under marketing arrangements approved by an Order of the Minister of Agriculture, Fisheries and Food (Statutory Instrument No. 839 of 1957) at prices based on the world free price of sugar. Any resulting deficiency is reimbursed by the Sugar Board or if there is a surplus this is payable to the Sugar Board. On its manufacturing and trading operations, therefore, the Corporation year by year is left with neither profit nor loss.

The Corporation's income is derived firstly, from "an amount equivalent to a reasonable rate of interest on the issued share capital of the Corporation for the time being, and on such of the reserves of the Corporation for the time being employed in the business of the Corporation as the Minister may determine". The rate of interest on the issued share capital of the Corporation is a rate similar to that charged on public authority loans and which for the years ended 31st March 1958 and 1959, was 3¾%. Interest on the reserves of the Corporation varies with the rate payable by the Corporation on its loan from the Sugar Board, although sums placed to reserve after 1956/57 receive a lower rate in accordance with the terms of the current Incentive Agreement. The second source of the Corporation's income is from earnings under an Incentive Agreement (Section 19 of the Sugar Act, 1956, and Statutory Instrument No. 936 of 1958). The object of this Agreement is to promote economy and efficiency in the Corporation's operations and, simply stated, is achieved by comparing the Corporation's actual costs, adjusted for price level variations, with predetermined operating standards. If actual costs are less than the standards then the difference is paid to the Corporation by the Sugar Board as incentive earnings. If, on the other hand, the costs for any year are in excess of the standards, such excess is payable by the Corporation to the Sugar Board, and would become a charge against the Corporation's other income for the year. The primary purpose for such incentive payment is to maintain the Corporation's buildings, plant and machinery in efficient and modern condition.

It will be appreciated, therefore, that although the Corporation is a company incorporated under the Companies Acts, it is not an ordinary trading concern but is the agency through which Government policy for the sugar beet crop is implemented. In consequence the value of the Corporation's assets and the level of its earnings are dependent on this Government policy as expressed in the Sugar Act and Orders made under it.

* * *

Bookers sugar in 1959.

During 1959 the estates for which Booker Bros. McConnell & Co. Ltd. sugar interests are responsible produced 232,468 tons of sugar—nearly 8% less than in 1958. Although the total acreage reaped was up by 3·1% to 68,937 acres, sugar yield fell by 10% to 3·31 tons per acre, largely because of the weather. In spite of the smaller crop, not all the available sugar could be exported, for the first time in recent years, because reallocations of Commonwealth export quotas were less than usual. Moreover the free market price of sugar, at which 40% of the crop is sold, fell, and this in combination with the fall in production inevitably caused a further decline in profits.

The drought of the preceding two years continued into the middle of 1959 when there was unusually heavy rain; from August to the end of the year there was enough rain but it was badly distributed. The effect of this was that the cane ripened when it should have been growing and *vice versa*. For the spring crop the sucrose content of the cane was reasonably good but the tonnage of cane to the acre was below

the previous year. For the autumn crop, the "boom" period of growth of much of the cane coincided with the spring drought, thus bringing the cane to early maturity, and the subsequent rainfall made it over-mature.

The abnormal weather brought further problems in its train, including a wide variety of insect pests and an unprecedented invasion of certain estates by rats driven onto the cane lands by the drying up of the savannahs. The infestation was in the end brought under control with over ten million p ison pellets being distributed in the fields, some being dropped by aircraft.

The policy of running a large number of ratoons has continued; it is now the aim of each estate to have 15% of its arable area in plant cane. This is equivalent to running six ratoons; the longer cycle may cause a drop in yield per acre but it is known that it will reduce costs of production. Irrigation trials are continuing and are accompanied by other experiments aimed at improving the physical condition of the soil so that the right supply of moisture at all times and adequate aeration will have an optimum effect on the cane.

Average factory output has been raised still further to 25,485 tons in 1959 compared with 24,782 tons in 1958 and 23,668 tons in 1957. The average milling rate increased from 68·9 tons of cane per hour in 1958 to 74·3 tons in 1959, and the average grinding week rose from 115 to 120 hours. Production time lost in the factories was again cut down, demonstrating the value of the preparatory work already done towards the introduction of a thorough system of planned preventive maintenance. A variety of new installations and improvements contributed to the increased rate of production and generally to keeping the equipment up to date.

The completed La Bonne Intention factory is the first in British Guiana to be entirely rebuilt since the war. It has a production capacity of about 35,000 tons a year and cane from the Ogle and Houston estates is being ground there as well as from the L.B.I. estate itself. A great deal of reconstruction was carried out at the factory at Wales estates where the grinding rate has been consideratly increased. Work on equipping the estates for handling sugar in bulk is keeping pace with the construction of the 40,000-ton bulk sugar storage and loading plant at Ruimveldt, on the east bank of the Demerara river.

* * *

Greek sugar industry[1].

The organization for the production of sugar in Greece has entered a definite phase and, towards the end of April, an agreement was signed at Thessaloniki, in the presence of Mr. KARAMANLIS, the prime minister, for the constitution of a commercial company "Hellenic Sugar Industry".

This company is to be set up by the Greek State and the Agricultural Bank of Greece in a proportion of, respectively, 10% and 90%, the Agricultural Bank of Greece undertaking to hand over 50% of their holdings to the Agricultural Co-operatives which will be set up by sugar beet cultivators.

It has been stated that: (1) the capital of this new company has been fixed at 200 million drachmae, (2) the total cost of the three sugar factories which are to be erected in Greece will amount to approximately 720,000,000 drs; 400 million of which refer to payments to be effected in foreign exchange and 320 million to expenses to be incurred in drachmae, (3) the production capacity of each factory will be about 28,000 tons of sugar per annum and that some 600 workers and clerks will be employed, and (4) approximately 9 million dollars in foreign exchange will be saved.

Some 70–80,000 stremmas (1 stremma = 1000 square metres) will be sown with sugar beets to produce the quantity of beets required to feed each factory. Taking into consideration that cultivation will be carried out on a rotation system, this means that the total area allotted for the cultivation of sugar beets will cover some 280,000 to 320,000 stremmas (28,000–32,000 hectares).

The preparatory work for the erection of the Larissa factory is well under way; it is reckoned that the foundation stone will be laid during this summer and that the factory will start operating towards the end of August 1961. The Thessaloniki and Serres factories are expected to start operating within the next two or three years.

* * *

Argentine sugar industry reorganization[2].

Measures are to be taken to reorganize the sugar industry in the Argentine. For some time the effects of over-production have weighed heavily on the domestic market and, whilst the export this year of some 200,000 tons has been widely forecast, it has been possible only to dispose of about three cargoes. Production costs are said to be about twice the present world price and it is this which has stood in the way of earlier disposal of sugar to overseas markets.

After the devotion of a considerable period of time to the study of the position a plan has now been evolved by the mill owners and the Government for the future regulation of the industry, according to a report issued by Messrs. Leng Roberts & Co. (London) Ltd.

Subject to the giving of an undertaking to limit production, and provided that measures recommended by the Argentine National Bank are carried out, credits are to be made available where they are required to enable mills to deal with the forthcoming crop. Furthermore, financial aid is to be made available to facilitate sales in both export and domestic markets. Emergency assistance will be provided to help workers and small-scale farmers whose livelihood may be affected by these restrictions.

[1] F. O. LICHT, *International Sugar Report*, 1960, **92**, (Supp. 9), 101.

[2] C. Czarnikow Ltd., *Sugar Review*, 1960, (457), 91.

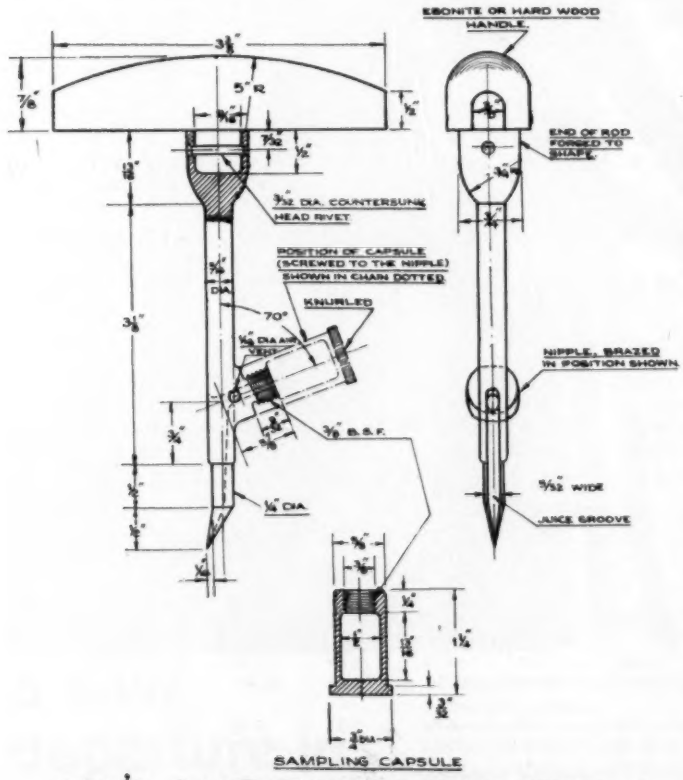
SELECTION OF CANE FIELDS IN SUCCESSION OF RIPENING

Successful Application of Sen's Puncturing Needle

By S. C. SEN.

[The payment for quality of cane grown by peasant farmers in small quantities has always presented a problem. In the following paper Dr. S. C. Sen, D.Sc., F.R.I.C., F.I.C., National Sugar Institute, Kanpur, adds a notable contribution.—H. M.-L.]

THE hand refractometer has long been used for evaluating the quality of sugar beet and sugar cane. Various workers[1–6] have suggested different internodes in the cane to be tapped for the representative value, but, unfortunately, in no case was their selection based on statistical analysis. KHANNA & SEN[7] were the first to work out statistically the particular internode to be tapped for the representative stalk Brix, after having proved that there was an almost negligible difference between the hydrometer Brix (corrected to 20°C) and hand refractometer Brix (the zero point of the latter being corrected with distilled water prior to reading the refractometric Brix). They also observed that the observed stalk Brix agreed very well with the stalk Brix calculated from the regression equations $y = 0{\cdot}76m + 3{\cdot}85$ and $y = 3{\cdot}03 + 0{\cdot}36m_1 + 0{\cdot}44m_2$, where y = stalk Brix, m = middle internodal Brix, and m_1 and m_2 = Brix values of the internodes immediately above and below the middle internode. For all practical purposes, including large-scale testing, the middle internodal Brix may be considered adequate for correct assessment.



SEN'S CANE PUNCTURING NEEDLE.

MATERIAL: STAINLESS STEEL, 18-8.

The problem now arises as to the size of sample necessary for true representation of the plot. KHANNA & SEN[8] and SEN[9] have already proved statistically that at least 10 whole clumps selected at random from a quarter-acre plot would be necessary for correct representation. Recently, SEN[10] recommended the sampling technique described in Appendix I to be followed for the assessment of the Brix values of standing crops, using the hand refractometer, and Sen's puncturing needle[11] (Fig. 1).

By adoption of this method a large number of cane fields can easily be assessed within a week and these fields arranged in succession of maturity in the harvest schedule. A difference of over 10°Bx has been observed between the two extremes of juice extracted from the plots in the reserved area of a factory. This

[1] ECKART: *Rpt. Assoc. Hawaii Sugar Tech.*, 1936, **15**, 5–7; 21–22.
[2] LENNOX: *Ibid.*, 1937, **16**, 26.
[3] DUNCAN: *I.S.J.*, 1937, **39**, 111.
[4] STEVENSON: *Central Breeding Sta. Bull.*, 1937, (16).
[5] BACHLAR: *J. Amer. Chem. Soc.*, 1938.
[6] SURRER MENA: *Trop. Agric.*, 1939, **60**, 22.
[7] *Proc. 22nd Conv. Sugar Tech. Assoc. India*, 1953, 133–140.
[8] *Dept. Agric. Bihar Leaflet*, 1937, (3).
[9] *J. Sci. Sol. H.B.T.I. & N.S.I.*, 1957, 36–43.
[10] *Proc. 26th Conv. Sugar Tech. Assoc. India*, 1958, 175–204.
[11] SEN: *Proc. 9th Congr. I.S.S.C.T.*, 1956, 389–396.

clearly illustrates the usefulness of the refractometer survey using Sen's puncturing needle.

EXPERIMENTAL

Experimental Sugar Factory, Kanpur, U.P., India.—The refractometric survey of 1000 plots under sugar cane earmarked for crushing in the factory during the 1956/57 season was completed within seven days using a Zeiss hand refractometer and Sen's puncturing needle, and the harvest schedule was drawn up in succession of maturity with the object of achieving better yield and quality at harvest and so to increase the overall recovery % cane. The fortnightly average pol % primary juice during the year when the scheme was launched (1956–57) and during the previous five seasons are given in Table I.

It is clear from these results that a factory can easily expect a recovery higher by at least 0·5% by applying assessment of juice quality of standing cane using Sen's puncturing needle.

North Bihar Sugar Mills Ltd., Bagha, Bihar.—The refractometric survey of 11,642 plots earmarked for North Bihar Sugar Mills Ltd. (a commercial factory

Table I

Period	1956–57	1955–56	1954–55	1953–54	1952–53
1st fortnight January	17·20	15·92	15·70	15·77	—
2nd ,, ,, ...	16·95	16·10	15·26	15·47	15·65
1st ,, February	17·36	16·78	15·77	15·31	16·21
2nd ,, ,, ...	17·87	17·25	16·70	Stopped	16·55
1st ,, March	17·71	Stopped	Stopped		Stopped
2nd ,, ,, ...	17·48				
1st ,, April	17·71				
Recovery % cane	7·84	6·82	7·30	7·00	7·11

Table II

1957—1958

	24.11.57 to 17.12.57	18.12.57 to 31.12.57	1.1.58 to 15.1.58	16.1.58 to 31.1.58	1.2.58 to 15.2.58	16.2.58 to 8.3.58	9.3.58 to 25.3.58	26.3.58 to 19.4.58	*To date average data at close of the season*
Cane Crushed (maunds) ..	424,243·25	315,284	337,061	332,162	354,837	385,734	334,804	436,915	2,921,043
Primary Juice:									
Pol	15·42	16·07	16·48	16·88	17·24	17·51	17·68	17·55	16·84
Purity	83·26	84·22	85·08	85·77	85·90	85·46	82·97	82·12	84·12
Molasses:									
%Cane.....	3·65	3·92	3·50	3·42	3·37	3·60	4·50	4·71	3·85
Purity	34·56	34·96	34·48	34·45	34·87	34·99	36·07	37·86	35·57
Sugar % cane	11·90	12·61	12·80	13·02	13·07	13·31	13·26	12·87	12·83
Fibre % cane	16·96	16·40	17·11	17·66	18·63	18·35	19·88	20·26	18·21
Recovery % cane ..	**9·36**	**10·11**	**10·35**	**10·61**	**10·59**	**10·75**	**10·30**	**9·90**	**10·22**
Total losses.....	2·58	2·54	2·49	2·56	2·54	2·63	3·02	3·06	2·68
Overall mill efficiency	78·32	79·86	80·55	80·34	80·57	80·26	77·22	76·22	79·11

1956—1957.

	27.11.56 to 16.12.56	17.12.56 to 31.12.56	1·1·57 to 7.2.57	8·2·57 to 16.3.57	17·3·57 to 16.4.57	*To date average data at close of the season*
Cane Crushed (maunds) ..	345,745·5	304,329·8	721,423	748,556	514,551·75	2,634,606
Primary Juice:						
Pol	14·90	15·00	15·02	15·73	15·89	15·37
Purity	82·91	83·01	83·40	83·18	79·89	82·46
Molasses:						
%Cane.....	3·85	3·89	3·70	4·08	5·01	4·11
Purity	35·24	35·30	34·98	35·49	37·61	35·91
Sugar % cane	11·63	11·63	11·44	11·95	11·76	11·69
Fibre % cane	16·39	16·53	16·52	17·09	17·85	16·92
Recovery % cane ..	**8·37**	**9·13**	**8·88**	**9·26**	**8·51**	**8·94**
Total losses	2·78	2·52	2·48	2·71	3·29	2·78
Overall mill efficiency	76·10	78·33	77·45	77·32	72·02	76·22

REMARKS: It appears from the results that the assessment of Brix values of standing canes by the application of SEN'S Puncturing Needle has been successful. This resulted in a higher recovery per cent cane in the mill. This factory was at the bottom or last but one in respect to recovery % cane for the past three seasons (1956-57 to 1954–55) in the State and in the year (1957–58) under investigation, the recovery % cane has been greatly increased and the factory occupied second position in respect to recovery % cane in the State.

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crushing about 1000 tons of cane per day) was completed within a week using Sen's puncturing needle. The cane plots were then arranged in succession of Brix values and crushed in the mill during the 1957–58 season. The results achieved during this season and the previous season (1956–57) are given in Table II. The experiment has been extended to other sugar factories and encouraging results have been obtained everywhere.[12,13] All these confirm that Sen's puncturing needle can be successfully applied for the assessment of Brix values of standing cane, permitting efficient utilization of the crop and achievement of higher recovery % cane. It may also prove helpful in a system of cane payment on a quality basis.

ACKNOWLEDGMENT

The author is indebted to Shri S. N. GUNDU RAO, B.Sc., A.H.B.T.I., F.A.Sc., F.R.I.C., Director, National Sugar Institute, Kanpur, for his encouragement in this work.

* * *

APPENDIX I

The maturity survey in connexion with the control of harvesting must be completed within a very short time, not exceeding 8–10 days on any account, and preferably within 5–7 days. Otherwise, the time factor will vitiate the assessed cane quality results. For timely completion of the work within ten days in a reserved area having 20,000 – 30,000 plots under cane, it is necessary to divide the area into 40–50 zones, each comprising 500–600 plots. For each zone, a team consisting of four coolies with puncturing needles and a refractometer analyst with a hand refractometer should move from field to field and complete a plot-wise quality survey, covering all the plots in the area assigned to it. For the quality assessment, four workers enter the plots from four sides of the field not exceeding half an acre and each extracts the juice from the middle internodes of all the canes of 4–5 clumps selected at random from their respective side. The juice is collected in the capsule of each needle and after completion of the work the contents of the four capsules are mixed in a beaker and the refractive index of the composite sample measured and recorded.

The recorded Brix readings of all the 40–50 zonal teams are summarised and arranged in order of magnitude for issuing of "challans" (harvesting dockets) on the basis of maturity.

N.B.—For a bigger area (more than half an acre), half acre sub-plots at the extreme ends should be marked and surveyed. The average of these two readings is the Brix of the plot. The end which indicates the higher Brix should be noted, e.g. 20·0 North, so that the harvest is started from that side. It is not necessary to survey the middle areas as the cultivator never harvests from the middle of the plot but always insists on harvesting from one side of the plot.

[12] SEN & SHARMA: *Proc. 27th Conv. Sugar Tech. Assoc. India*, 1959, 174–177.
[13] SEN *et al.*: *ibid.*, 91–96.

AGRICULTURAL ABSTRACTS

The management of water on Hawaii sugar cane plantations. G. Y. EWART. *Sugar J.* (La.), 1959, **22,** (5), 9–17.—The system of controlling the irrigation programme by the use of gypsum blocks, now used over some 55,000 acres, is described in considerable detail. At Kekaha, where these blocks were first used, the earliest 9 fields have surpassed their previous record yield with savings in irrigation. Costings show $0.90 per acre/year or $0.15 per ton of sugar.

* * *

Rotary tillage in sugar cane production. W. H. CARTER. *Sugar J.* (La.), 1959, **22,** (5), 33–35.—With the renewed interest in the rotary hoe, the openings for its use in the cane cultivation cycle and the mechanical principles on which it is based are discussed.

* * *

Organization planning and supervision. R. L. WOLD. *Sugar J.* (La.), 1959, **22,** (6), 17.—The divisional organization, under which the 13,500 acres of cane land at Lihue were arranged in 4 geographical divisions, was superceded in 1952 by a functional organization with 4 major departments, cultivation, weed control, irrigation and harvesting. The relative strong and weak points of the two systems are compared.

Helping the farmer to decide on spray irrigation. ANON. *S. African Sugar J.*, 1959, **43,** 979–987.—The article, the publication of which has received the sanction of the Industrial Field Mechanization and Labour-saving Committee, discusses first those factors on which any scheme depends for its economic running, the supply of water both in quantity and quality, the permeability of the soil and the "peak-use" of water. It goes on to discuss the various systems of layout and the mechanical equipment required for each.

* * *

The influence of the age of sugar cane on its leaf-nutrient (N-P-K) content. G. SAMUELS. *J. Agric.* (Univ. Puerto Rico), 1959, **43,** 159–170.—The age of cane is found to exert a definite influence on nutrient content. N content decreases with age, the decrease during the first 7 months being 2·5 times as great for unirrigated as compared with irrigated cane and more rapid in ratoons compared with plant. Phosphorus showed a marked decrease up to 4 months with an increase after 9 months to 14 months. Potassium showed a slight decline at first but a definite increase, commencing in unirrigated cane at 5·5 months and in irrigated at 15 months. A provisional table of correction factors is given.

RATOON STUNTING DISEASE IN MAURITIUS[1]

A WELL-ORGANIZED system has been built up in Mauritius to meet the threat of ratoon stunting disease. It consists of two centres for treatment of the setts and a series of nurseries from which planting material is distributed. For the purpose, the planting community is divided into three categories: the owners of factories, large planters (cultivating over 100 arpents) and small planters. Each has its own organization for the distribution of treated material, respectively the Mauritius Sugar Producers' Association, the Cane Growers' Association and the Sugar Planters' Rehabilitation Fund Committee. They draw treated material from two centres, one at Reduit with a capacity of ½ ton per treatment but also used as an experiment station for the Sugar Research Institute, and the other at Belle Rive with a capacity of 1½ tons and under the control of the Mauritius Sugar Planters' Association.

With a total of 23,000 arpents under cane, it is clearly impossible to plant the whole area direct with treated material, and it is necessary to work through nurseries; this requires the treatment of 9200 tons, 5000 tons for the factory owners with 12,500 arpents under cultivation, 1400 tons for the large planters (3500 arpents) and 2800 tons for the small planters (7000 arpents). So far, between June 1958 and June 1959, 3515 tons have been treated and 961 arpents planted.

The success of the programme depends on the possibility of finding a combination of temperature and length of treatment which will ensure the destruction of the virus without injuring the viability of the setts. Too high a temperature is more harmful than prolonged immersion. A temperature of 50°C for 2 hours with between 20 to 30 minutes additional allowance for the cane mass to heat up is suggested.

Comparisons are drawn between Mauritian experience and that of Australia on the several factors which influence the success of the treatment. There is a considerable varietal difference in response, with B 37172 most resistant and Ebène 1/37 at the other extreme; there is the period of the year at which the setts are taken, those taken during the period of vigorous growth appearing most subject to injury, and there is the question of the section of the stalk which responds best. This latter appears to be that upper part which remains after elimination of the white butt. From experience with M 147/44, it seems desirable to trash the cane a week or more before collecting the setts. Mauritian experience further suggests that excess moisture in the soil at time of planting is even more harmful to germination than prolonged drought. Some success has followed the addition of urea (0·25%) to the hot water during treatment, the comparative germination figures being 48% for untreated setts, 31% for treated setts with urea added and practically nil after treatment with hot water only.

[1] R. ANTOINE: *Rev. Agric. Sucr.* (Mauritius), 1959, **38**, 214–221.

AGRICULTURAL ABSTRACTS

Round-table discussion on infield cane handling. ANON. *S. African Sugar J.*, 1959, **43**, 1041–1046.—The first symposium, since its inception, of the Industrial Field Mechanization and Labour-saving Committee limited its discussion to the problems of infield cane handling. The problems covered included not only mechanical equipment but the saving of labour and the question of soil compaction. Unfortunately, conditions such as, for example, the slope of ground are so divergent that no universal principles could be evolved.

* * *

Studies in *Saccharum spontaneum*. The flowering behaviour of latitudinally displaced populations. R. R. PANJE and K. SRINIVASAN. *Bot. Gaz.*, 1959, **120**, 193–202; through *Plant Breeding Abstracts*, 1960, **30**, 613.—Among 341 clones, collected from latitudes 5°–35°N. in India and grown at Coimbatore (11°N.), those from 5°–19°N. all flowered, while among those from above 20°N. the number flowering was inversely related to the latitudinal distance from Coimbatore. Tested over a period of six years, most clones tended to flower either every year or not at all. Clones were also grown at Karnal (29° 42′N.), and in those which flowered at both latitudes, flowering was generally later at Karnal. Clones native in latitudes 25°–29°N. flowered earlier at Karnal than clones native in latitudes 10°–14°N. did in Coimbatore; when the former group was grown at Coimbatore and the latter at Karnal, they were respectively accelerated and delayed in flowering by about 40 days. This gives a mean shift in flowering date of 2·4 ± 0·09 days per latitudinal degree. From this value, the approximate date of flowering in the native habitat has been calculated on the basis of flowering times at Coimbatore and Karnal. The calculated date was correlated positively with the ending of the monsoon in that region, a factor which has probably had an important selective effect upon the species. It is noted that variants from areas of high rainfall in Assam and Nepal fail to flower both at Coimbatore and at Karnal, although the latter is at about the same latitude as the original habitat; these may in some cases be induced to flower by allowing them to grow for a second year. It has also been observed that flowering is profuse in dry areas with a short seasonal monsoon and in areas subject to periodic waterlogging. It is suggested that the tendency to excessive flowering in interspecific hybrids with sugar cane may be overcome by the use of normally nonflowering variants of *S. spontaneum* as parents, or by the use of late-flowering variants or of variants specially sensitive to latitudinal displacement.

THE DEVELOPMENT OF MHLUME

By ALEX HAMMOND

Reprinted from The South African Sugar J., 1960, **44**, 193–199.

THE story of Mhlume—or, to give it its full title, Mhlume (Swaziland) Sugar Co. Ltd.—can be summed up in the translation of the Swazi word *mhlume*—"the promise of good things to come". It was the Paramount Chief of the Swazis who gave the area its name when, in opening the canal which carries water from the Komati River, he referred in his native tongue to the benefits the water would bring and the promise it held for the future.

The company was formed in June 1958 under the Swaziland Companies Proclamation. It is owned by Sir J. L. Hulett & Sons Ltd. and the Colonial Development Corporation of Great Britain, who have large interests in the territory.

Field Work

Before the formal incorporation, however, C.D.C. and Hulett operatives had started the tremendous task of bush clearing and preparing the soil for the first crops. In the short space of two years 9000 of the 13,200 acres owned by the company have been cleared of bush and 7800 acres planted with cane. In addition, a modern factory has been erected and fitted. During the author's visit, at the end of January, it was in the course of being commissioned. Production started in March.

Some may have expected progress to have been faster, but the company had many difficulties to contend with, chief among them being that every item of equipment, from a large 42-ton accumulator to packets of screws and nuts, had to be carried by road from either Gollel or the nearest railpoint at Komati, 55 miles away. To add to the company's problems telephones for a long time were nonexistent and postal communications were not of the best.

When it is recalled that the first men to arrive found only bush country, the magnitude of the task which confronted them, of not only preparing the lands and erecting a factory, but also of establishing housing, electricity, sewerage, water service, roads, administration headquarters and so on, can be appreciated. Today the General Manager, Mr. K. C. Riggs, is able to state with justifiable pride that "we are confident that we shall fulfil our 40,000 ton quota in our first full season of operation".

Mhlume lies almost in the shadow of the Lebombo Mountains between the Komati River in the north and the Black Umbulazi River in the south. The water which is so essential for its survival is obtained from a 41-miles long canal which links the area with the Komati River, 25 miles to the north. This water is purchased from the Colonial Development Corporation.

The climate is sub-tropical. Statistics taken over the past 38 years show that the highest rainfall normally occurs between November and March, with a mean average of 4·5 inches for January. The maximum mean shade temperature is 77°F in the summer months, while the humidity exceeds 50% from October through to April. Rainfall records disclose, however, that not infrequently up to 10 in per month can be experienced in the January-March period. Normal annual rainfall varies between 18 in and 34 in.

After clearing the bush the practice has been to rip the soil at 3 ft centres and remove roots to a depth of 18 in. This has been followed by harrowing with heavy discs before ridging and planting. The latter operation has been done by hand.

Some idea of the rate of development is revealed in the acreages cleared and planted. The highest figure for planting in a day was 48 acres and highest average for a week was 248 acres.

The fields at Mhlume have been planted with N:Co 310, the cane for seed having been planted earlier by the C.D.C. in co-operation with Hulett's. In September 1959 the company was able to obtain its seed cane from its own fields, the yield being 42 tons to the acre at ten months. Small acreages of N:Co 293, N:Co 339, N:Co 334 and N:Co 376 are at present on trial.

Germination has been found to be exceptionally good, in fact outstanding, says Mr. P. H. Mahon, the field manager. First shoots have appeared in as little as five days in the hottest months of January and February. Planting is possible all the year round with the exception of the colder months of June and July. The seed cane is not hot-water treated nor is a fungicide necessary, owing to the fast germination.

In all there are eight night storage dams for irrigation, the largest covering 15 acres and the smallest five acres. Water is led from the storage dams into section canals and finally into the fields. Four units of labour are responsible for the handling of ½ cusecs a day. The average rate of application is between three and six inches of water per acre per month, according to seasonal climatic conditions. Optimum application is during September and October.

Before harvesting it is intended to dry-off for a period varying between three and five weeks, depending on the soil and expected climatic conditions at that time of the year.

When the fields were first opened for planting, fertilizer was applied at the rate of 400 lb superphosphate, but latterly this has been changed to 400 lb hyper-rock-phosphate (30% total phosphates). Top dressing in the main consists of 400 lb ammonium nitrate (33% nitrogen) and 400 lb muriate of potash, split into two applications. Ratoon crops will in all probability receive the same treatment as plant cane. In one acre of 1700 acres the second nitrogenous application was in the form of 150 lb of urea per acre, put down by air.

Because the undertaking is a new one and the field staff is dealing with virgin soil, control plots are being laid down with a view to introducing some form of fertilizer trial. In the same way constant soil surveys are planned to prevent the formation of brak conditions in the years to come by incorrect water application.

The company has not yet used herbicides for weed control, preferring to cultivate the rows. It is interesting to note that a Cotton King type of cultivator as used in Australia, and, incidentally, at Darnall and Kearsney on the Natal North Coast since 1954, is being used for the purpose.

It is anticipated that harvesting will take place when the cane is between 14 and 17 months old. A policy of trash conservation will be followed with the object of improving the friability and general characteristics of the soils which are predominantly heavy. The length of the crushing season is expected to be between eight and nine months, the aim being to finish before the rains start in November and December.

From the experience gained in handling seed cane the company prefers the Perry rear-end loader for picking up the stacked cane and for transport purposes. The system to be followed is for two cutters to have a basic task of four tons. The stacks will be transhipped from the Perry loader to two trailers in tandem and the final load will be carried on the loader. In this way three units will carry 12 tons on each run to the factory. The longest haul is 5 miles.

This, then, is the agricultural picture. On the organization side the area has been divided into 14 sections each of about 600 acres under the control of a section manager. Each section is self-sufficient in the way of equipment and buildings. Each will have its own labour force and the establishment of villages for the field workers, as distinct from compounds, is under way.

As the company is dependent on local voluntary Swazi labour it hopes to develop a settled force and to this end is concentrating on the provision of married quarters. Each village has proper ablution blocks and shower rooms, and that very important item—purified water.

As far as the European executives and employees are concerned—excluding the section managers—they are housed in a well laid out modern township. In all 220 acres have been set aside for this purpose, thereby making adequate provision for the subsequent development of recreational facilities. By the end of January 80% of the housing project had been completed, while the remaining 20% was in the course of completion. Proper water-borne sewerage has been installed.

Factory personnel are also accommodated in this village, while non-European factory workers have their village near the factory.

Factory Development

In December 1958 work on the factory was started; now it is in full production. Here again there was nothing but bush at the start—in fact the first equipment to arrive at the site was off-loaded by means of a block and tackle hitched to a tree. That tree still stands next to the millyard overhead gantry.

To expedite work in view of the difficult transport position the overhead gantry was erected first and brought into use immediately to unload the heavy-duty R.M.T. trucks bringing in equipment and machinery. The future stand-by 310 kW diesel-alternator was installed in a shed on the site of its final planned position to supply initial electricity.

A feature of the factory is that it has been designed to meet future development. Its present crushing rate is 75 tons an hour at a roller speed of 50 ft per minute, which can be increased immediately to 105 tons an hour by speeding up the turbines to a roller speed of 70 ft per minute. The crushing rate can be further increased to an estimated 200 tons per hour by opening up mill settings and additional turbine nozzles. The mills are 66 in wide by 36 in diameter. Each mill unit has an underneath pressure feeder and each intercarrier is driven from the preceding mill.

Each intercarrier consists of an endless rubber belt as opposed to the slat-type in use in Natal and Zululand factories. Another unusual feature is that the bagasse carrier instead of going overhead as is common elsewhere, goes underground before being elevated to the boilers. This has allowed an access road to run through the main fabric of the factory, between the mill train and the boiler house, suitably commanded by the 20-ton millhouse crane. This design enables equipment to be off-loaded inside the factory and will permit a further milling unit to be installed, if necessary, without alteration to existing plant lay-out.

The crushing train consists of six 3-roller mills without shredder. It is completely automatic and is supervised by one European who also, on shift, will be in charge of the boiler house.

The boiler house has three water tube boilers each having 50,000 lb capacity and a working pressure of 250 lb p.s.i., but designed to give 475 lb p.s.i. if required. Control of firing is fully automatic.

In place of the conventional vacuum pumps use is made if water/air ejectors.

Clarification is by the simple defecation process, the juice passing through heaters at a temperature of 212°F before entering the hot liming tanks. Hydrated lime is used, eliminating the need for a lime slaker. Control of pH is fully automatic.

Another feature of the factory is that the pan condensers have been lifted to the 90 ft level, to allow the sealing tanks to be high enough to gravitate return water to the cooling pond sprays.

The pan and crystallizer floors are built on a central island within the pan house, so that all sides are open to the overseer, who has at all times a clear view of the centrifugals and other plant.

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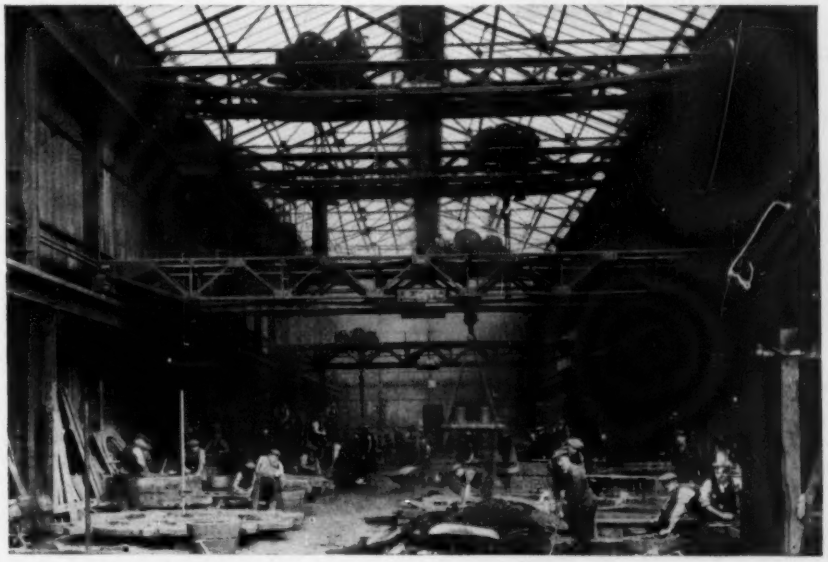

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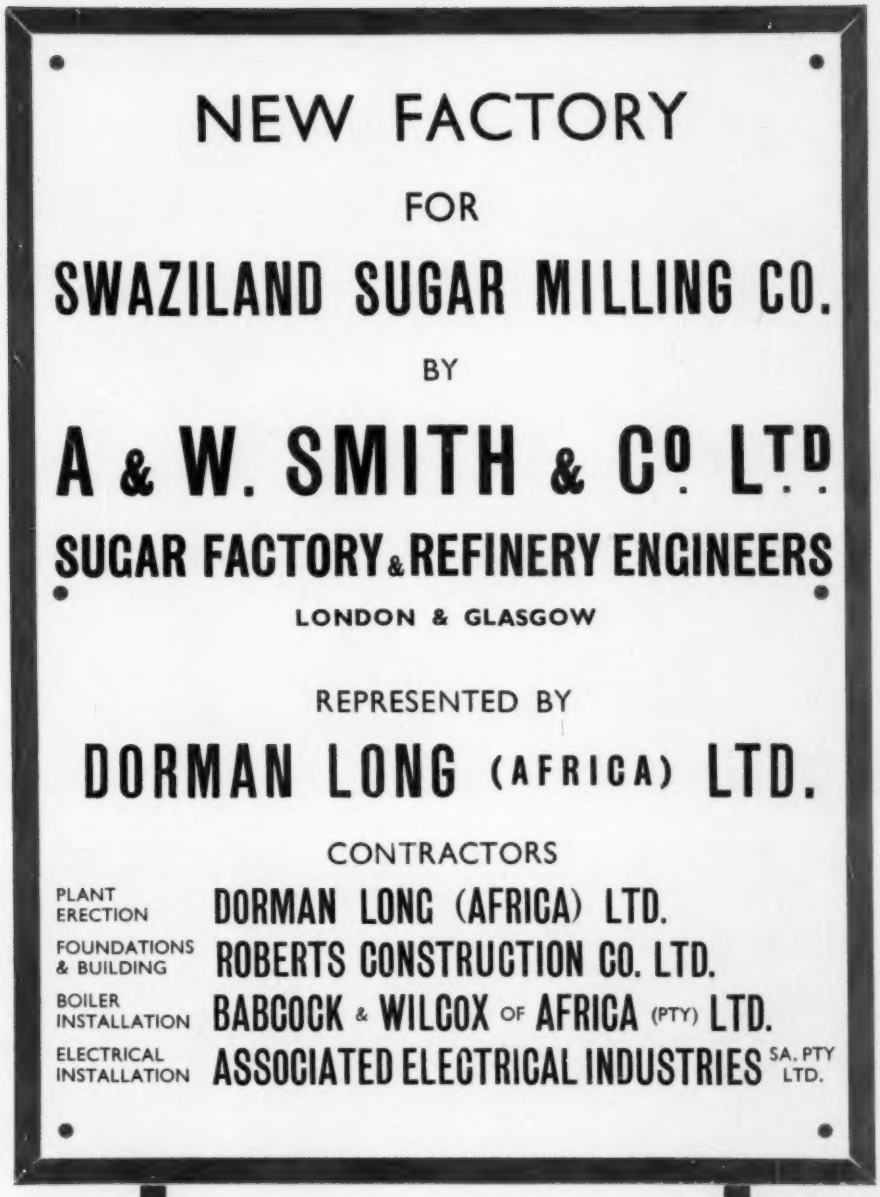
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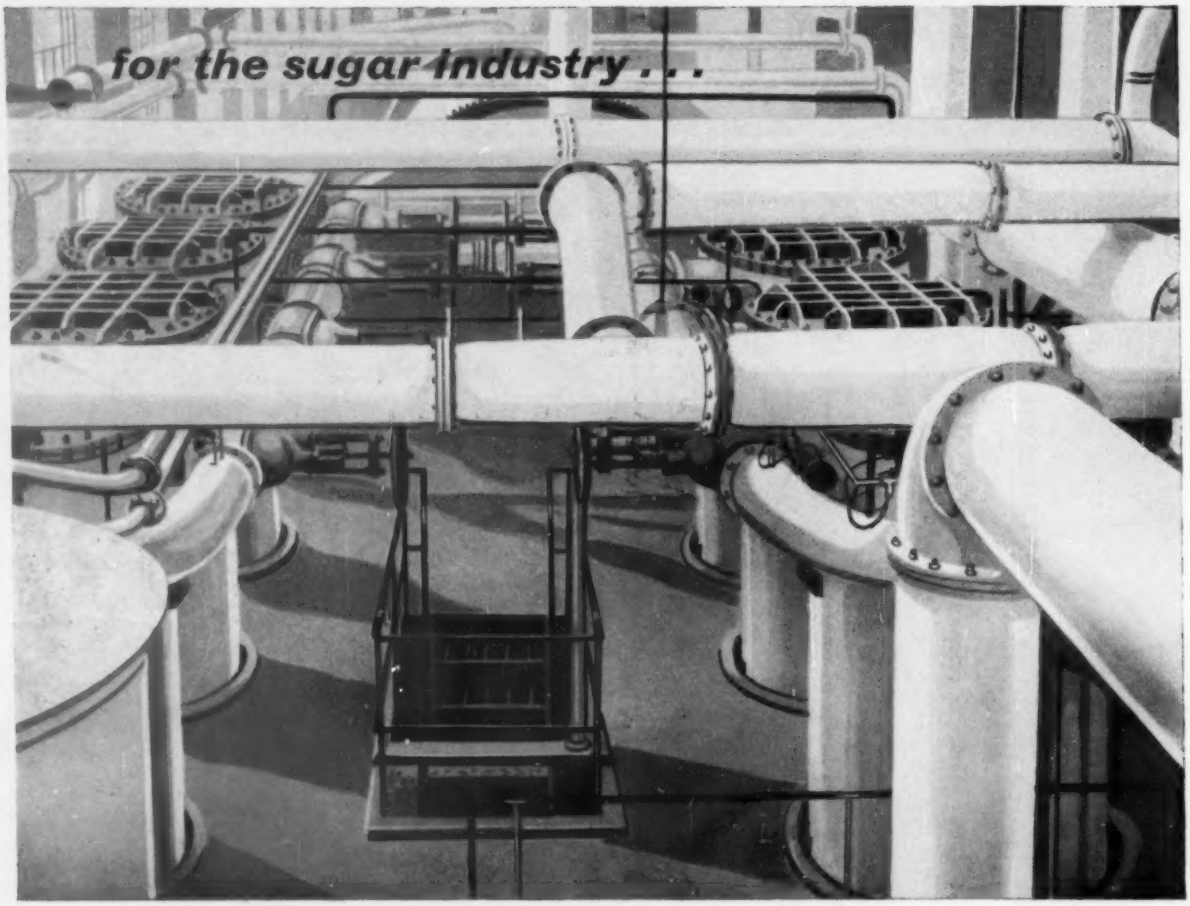
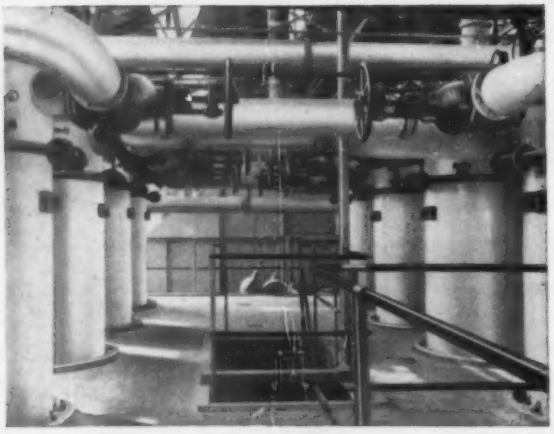


FLETCHER JUICE HEATERS



In these illustrations we show nine mild steel JUICE HEATERS which have been supplied to the British Sugar Corporation's factory at Ely. Each heater has a heating surface of 220 sq. metres and will work in conjunction with the largest R.T. Diffuser so far manufactured, which has a diameter of 6.75 metres. For some years now the Fletcher organisation has been supplying top quality machinery to both the beet and the cane industry at home and abroad.

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back to the white sugar pans. The remelt plant has automatic temperature and brix control. Whites and raws are conveyed along separate belt conveyors to the sugar floor.

Cane for the factory can be stockpiled under the 360 ft by 70 ft millyard overhead gantry. The main cane carrier is divided into two sections. A set of levelling knives of American design is situated at the nose of the first half of the main carrier at a point where it discharges onto the second. A further set of heavy-duty knives are installed on the second half. The speed of both carriers is automatically controlled without supervision, by the depth of the cane mat passing through the first mill.

These are some of the features of the factory, which is the first completely new factory if its size to be erected in Southern Africa.

The story of Mhlume is indeed one of achievement, the story of "the promise of good things to come".

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POLYSACCHARIDES AND THE VISCOSITY OF MILL SYRUPS

By G. K. SUTHERLAND*

(Research Department, The Colonial Sugar Refining Co. Ltd., Sydney, Australia)

BECAUSE of the importance of liquor and syrup viscosity to vacuum pan boiling and to exhaustion, regular viscosity checks have been made in these laboratories on weekly syrup samples from several Australian and Fijian mills. The measurements have shown that mills syrups vary considerably in viscosity. Furthermore, large increases in viscosity have been noticed for successive weekly samples, followed by sharp falls in viscosity back to the general operating level.

The presence of polysaccharides in mill materials has also been the subject of several investigations. The presence of dextran was demonstrated in cane and in sugar juices, and was found to occur in epidemics[1,2]. A connexion was also shown to exist between the dextran level in cane juices and the filtrability of the sugar produced[3]. Preliminary work with molasses at the Sugar Research Institute in Queensland has indicated that soluble polysaccharide material appreciably increased molasses viscosity[4].

* Present address: Shell Chemical (Australia) Pty. Ltd., Melbourne, Australia.

[1] NICHOLSON and LILIENTHAL: *Aust. J. Biol. Sci.*, 1959, **12**, 192.
[2] DAVIS: *I.S.J.*, 1959, **61**, 300.
[3] NICHOLSON: private communication.
[4] FOSTER *et al.*: *Proc. 24th Conf. Queensland Soc. Sugar Cane Tech.*, 1957, 223; *I.S.J.*, 1958, **60**, 79.

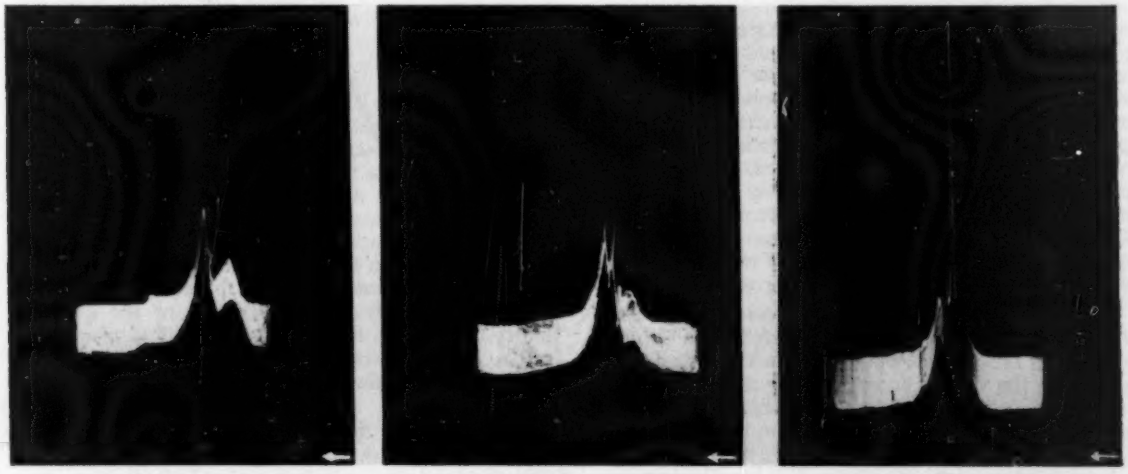


Fig. 1A. Fig. 1B. Fig. 1C.

Fig. 1. Electrophoretic patterns of alcohol precipitates from Rarawai B syrups; borate buffer, pH 9·5; approx 1·5% solution, 6 ma., descending boundary exposed at 60 min.
A: From syrup 4/10/58, viscosity 115% sucrose.
B: From syrup 15/11/58, viscosity 141% sucrose.
C: From syrup 22/11/58, viscosity 223% sucrose.

Removal of impurities from molasses by addition of alcohol led to a sharp reduction in the viscosity of the residual molasses[5].

Any soluble polysaccharides of the dextran class which are at present in cane might be expected to pass through the clarification stage, where indeed they appear to interfere with the clarification[2]. It was reasonable to expect, therefore, that dextran epidemics in cane juice could reach the syrups and cause the sudden viscosity increases which had been noticed. Certain high-viscosity syrups from several mills were selected, and the polysaccharide materials from these syrups was investigated[6].

Polysaccharides in Syrups

Viscosities were measured at 60°C and 73°Brix with a Höppler rheoviscometer, and expressed relative to the viscosity of a sucrose solution at the same concentration and temperature.

Dilution of a mill syrup with water was found to cause the irreversible precipitation of a material with a high ash content. Further precipitation with ethanol removed more material, only part of which would redissolve in water. This water-soluble fraction also had a high ash level, and gave chromatographic evidence after hydrolysis of the presence of galactose, glucose, arabinose and xylose, as well as traces of rhamnose. Removal of alcohol from the syrup supernatant and reconcentration back to a standard Brix showed that the viscosity of the residual syrup was only slightly higher than a standard sucrose solution under the same conditions, indicating that nearly all the viscosity-producing material had been removed.

The presence of soluble polysaccharides in the syrup could be expected to have a dispersing effect on some of the inorganic materials that would otherwise be insoluble. Dilution with water or addition of alcohol probably disrupts the colloidal system, causing the partly irreversible effects noticed. When the water-soluble fractions of the alcohol precipitates from a series of syrups were examined, an immediate connexion was noticed between syrup viscosity and polysaccharide content. These impure polysaccharide fractions from low, intermediate and high-viscosity syrups were examined with the aid of a Perkin-Elmer moving-boundary electrophoresis apparatus.

Fig. 1 shows the number of polysaccharides and the relative amounts of each obtained from syrups from a Fiji mill. These patterns show the boundaries formed by the various components in the crude polysaccharide preparation; the area under the peaks gives a measure of the relative amounts of each component. As the viscosity of the syrup increases, a large peak is seen to appear (the broad peak on the right of each pattern is due to a starting-boundary anomaly, and does not represent a component). Figs. 1B and 1C are from syrup samples taken one week apart, and show the sudden increase in one component in parallel with a sharp rise in viscosity.

When the component sugars from these crude polysaccharide preparations were examined by hydrolysis and chromatography, the material from high-viscosity syrups showed a much stronger glucose spot than that obtained from low-viscosity syrups. This suggested that a dextran polysaccharide, which had been found previously in stale cane[1], was occurring in the syrups and contributing to their high viscosity. Further evidence for the presence of a dextran was the high positive optical rotation of the isolated polysaccharide[6].

The Importance of the Colloid System

The inorganic material present in the colloidal syrup dispersion probably has an important effect on viscosity. The soluble polysaccharide material was separated from the low molecular weight components by dialysis, and was found to be only a small part of the total colloidal material (Table I). These data show that a high syrup viscosity is associated with a high level of colloidal material and of soluble polysaccharide.

Table I
Viscosity and Colloidal Levels in Syrups

Source	Syrup Grade	Viscosity % Sucrose	*Colloid Level g/100 g 73°Brix syrup	†Soluble polysaccharide g/100 g 73°Brix syrup
Mill 1	B	232	3·24	1·03
Mill 2	B	228	5·92	—‡
Mill 1	B	189	3·15	0·62
Mill 1	B	182	4·39	0·93
Mill 2	B	177	3·65	0·79
Mill 3	B	173	3·28	0·79
Mill 4	AB	114	2·75	0·28
Mill 3	B	112	0·80	—‡
Mill 5	A	100	1·39	—‡

* Precipitated with 4 vol ethanol from 50°Brix syrup.
† Precipitated with 4 vol ethanol after 60°Brix syrup was dialysed for 96 hours in the cold.
‡ Not measured.

Conclusion

The difficulties in vacuum pan boiling associated with high syrup viscosities appear to be due, at least in part, to the presence of dextran in the syrup. This is probably due in turn to the occurrence of dextran in the cane. The dextran probably has a dispersing effect on certain insoluble materials, so that they carry over from clarification and contribute to the viscosity increase. Delay in the crushing of cane after burning and/or after harvesting appears to be a major factor in the abnormally high production of the dextran material. This in turn affects the boiling properties of the syrups adversely, and consequently the quality of the sugar produced.

Acknowledgments

The author wishes to thank the management of The Colonial Sugar Refining Co. Ltd., Sydney, for permission to publish the paper, and R. I. NICHOLSON of this Department for helpful discussion.

[5] FOSTER and WRIGHT: *Tech. Rpt.* (Sugar Research Inst., Mackay), 1958, (51), 16; *I.S.J.*, 1959, **61**, 367.
[6] SUTHERLAND: to be published.

THE ISOLATION BY MEMBRANE DIFFUSION OF CERTAIN BROWNING PRODUCTS FROM CANE FINAL MOLASSES

By W. W. BINKLEY

(New York Sugar Trade Laboratory, 37 Warren Street, New York 7, N.Y., U.S.A.)

THE "browning" polymers play a veritable Jekyll and Hyde rôle in the food industry. While these polymers contribute essential colour and taste to such widely differing products as bread and maple syrup, they also act adversely along with other melassigenic substances to limit the yield of sucrose from sugar cane. Some of our recent researches have been concerned with the structural elucidation of the dialysed (membrane retained) "browning" polymers from cane final molasses[1]. The average molecular weight of these polymers was found by ultracentrifugation to be 27,000 ±1,000[1b]. We wish to report herein the isolation by membrane diffusion and some of the properties of certain "browning" polymers from cane final molasses.

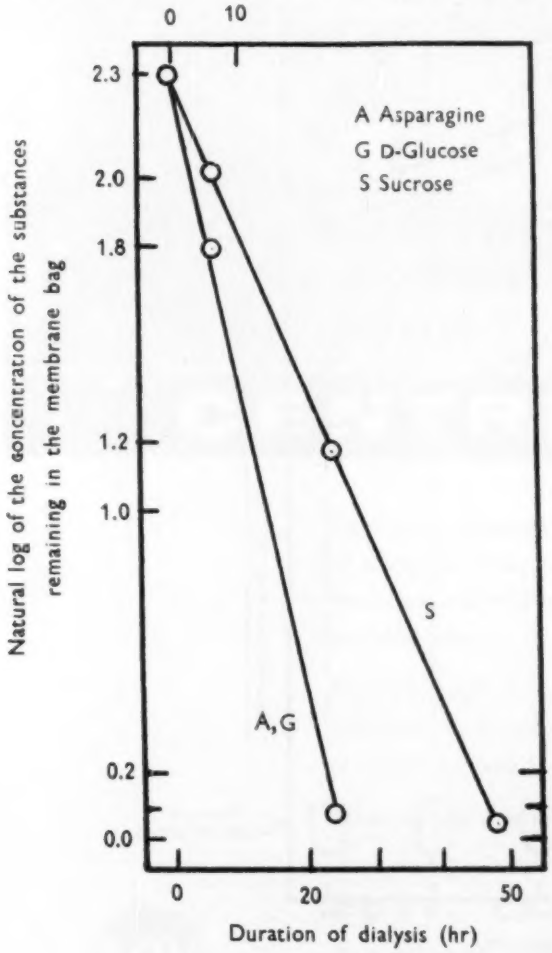


Fig. 1

EXPERIMENTAL

Dialysis of Asparagine, D-Glucose and Sucrose

Aqueous solutions each containing 1% of one of these substances were dialysed separately against toluene-saturated demineralized water in the apparatus used for the calibration of the membrane[1b]. The rate of escape of asparagine from the membrane bag was followed by the method of SORENSEN[2], D-glucose by the method of LANE and EYNON[3], and sucrose by direct polarization. These data are presented in Fig. 1.

Fractionation of Molasses by Membrane Diffusion

Twenty grams of Florida final molasses[4] were dissolved in 500 ml of distilled water and the resulting solution was saturated with toluene. This mixture was poured into a membrane bag made from a 26 inches length of cellulosic tubing 2·25 inches in dia. and 0·0023 inches in wall thickness (Central Scientific Co., Chicago, Ill., U.S.A.). The contents of this membrane bag, saturated with toluene and continuously stirred mechanically, were dialysed against toluene-saturated demineralized water for 48 hr in an apparatus which permitted the complete change every 2 hr of the solution outside of the bag. This solution was replaced then with 1800 ml of toluene-saturated distilled water which was used to collect the diffusates during 96 hr of additional dialysis. When five lots of the diffusates (representing 100 g of molasses) had been collected, the volume of the combined fractions was decreased to 500 ml by reduced pressure evaporation at 60°C. The solute content of this concentration of this concentrate was determined by partially dewatering aliquots of it by freeze-drying followed by drying the residue at 25°C over phosphoric anhydride under reduced pressure and was found to be 14·0 mg/ml.

Isolation by Membrane Diffusion of Certain Molasses "Browning" Polymers

The calibration of the cellulosic membrane has been described[1b]. The concentrate of the diffusates con-

[1] BINKLEY: *I.S.J.*, (a) 1957, **59**, 64, 178; 1958, **60**, 62, 165, 322; (b) 1960, **62**, 36.
[2] *Biochem. Z.*, 1907, **7**, 45.
[3] *J. Soc. Chem. Ind.*, 1923, **42**, 32T.
[4] Kindly supplied by the United States Sugar Corp., Clewiston, Fla., U.S.A.

taining the polymers was dialysed for 96 hr against toluene-saturated demineralized water in the apparatus used for the calibration of the membrane. Aliquots of the solution inside the membrane bag were removed at selected intervals and their optical densities observed at 420 and 490 mμ. The solids contents of these aliquots were determined by a combination of freeze-drying and desiccation over phosphoric anhydride. These data are presented in Fig. 2. The solution of polymers remaining in the membrane bag was concentrated to 100 ml by reduced pressure evaporation at 60°C and the polymers were isolated by lyophilization, yield 820 mg. The polymers were golden coloured, Molisch test positive, ninhydrin test negative, having optical density in 1% aqueous solution 6·48 at 420 mμ and 2·63 at 490 mμ, and elemental analysis C 46·06, H 5·52, O 39·82, N 3·95, ash 7.5

Paper Chromatography of the Progress of the Dialysis During the Isolation of the Polymers

Five to twelve additions of the solutions removed from the membrane bag at the intervals indicated in Fig. 2 were made at designated positions on a 15 × 18 cm sheet of Whatman No. 1 filter paper. The chromatogram was developed at 25°C with 1-butanol : ethanol : water (2:2:1 v/v/v) and was dried in air at 25°C. It was developed and dried twice more. The chromatogram was sprayed with sodium metaperiodate-potassium permanganate reagent[5] and is depicted in Fig. 2. An identical chromatogram was

[5] LEMIEUX and BAUER: *Anal. Chem.*, 1954, **26**, 920.

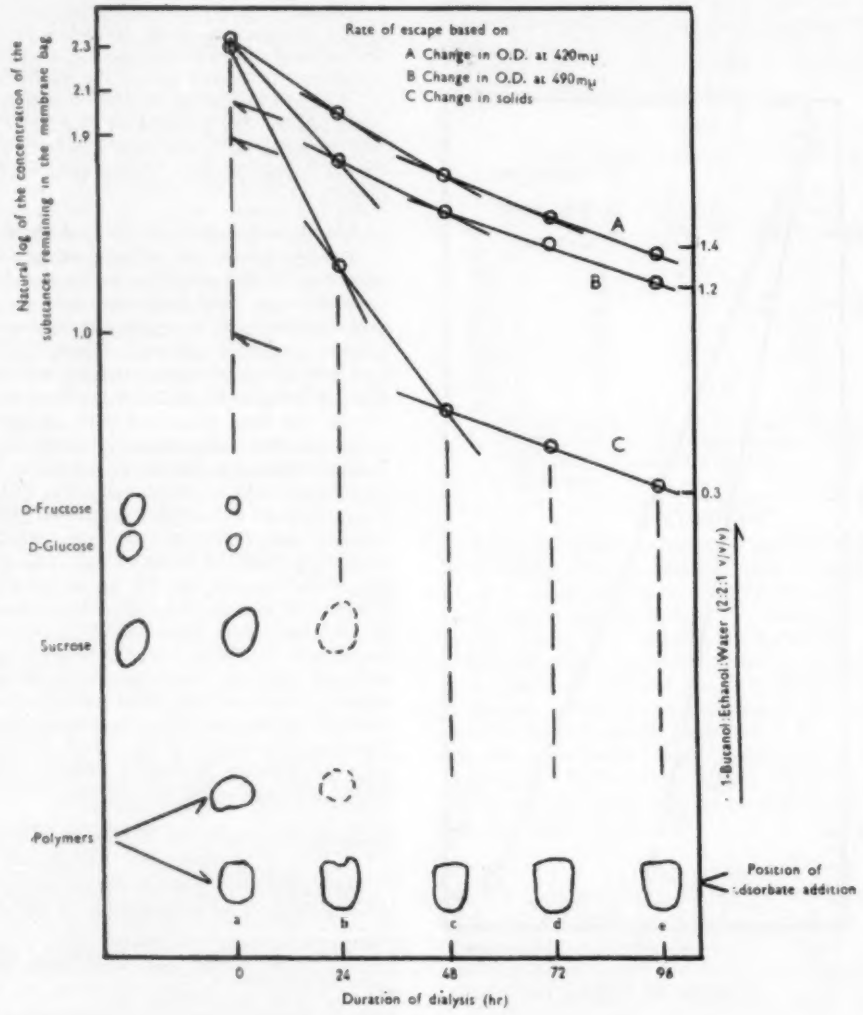
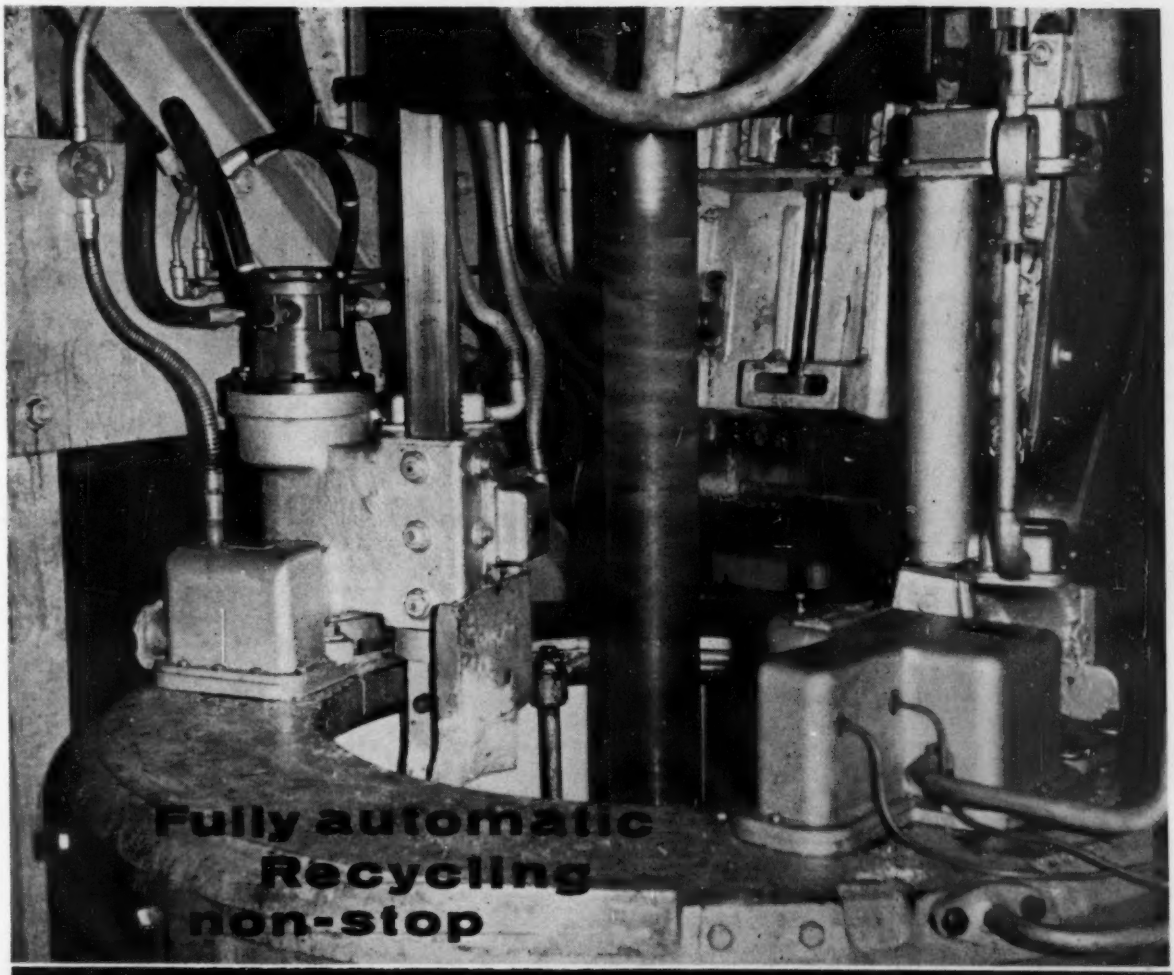


Fig. 2



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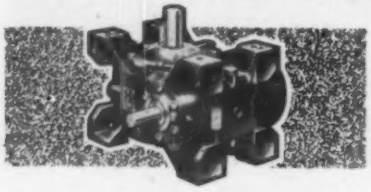

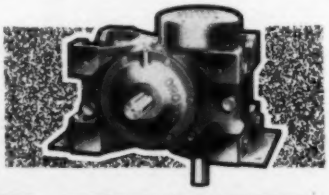

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sprayed with ninhydrin. The presence of amino-acids was noted in the zero and 24 hr aliquots only.

Calculations

The rate of diffusion of a substance through a membrane may be represented by equation (1);

$$\frac{dc}{dt} = kc \quad \ldots\ldots (1)$$

c = concentration, t = time, and k may be considered as a function of the molecular weight and of the properties of the membrane. When equation (1) was rearranged to equation (2)

$$\frac{dc}{c} = k\,dt \quad \ldots\ldots (2)$$

and integrated, equation (3) was obtained.

$$\ln c = kt + C, \text{ or} \quad \ldots\ldots (3)$$

$$\frac{\ln c}{t} = k + C'$$

The $\frac{\ln c}{t}$ value for the molasses polymers herein reported was found to be —0·0071 from the slope of the line depicting their escape through the membrane (Fig. 2 C). Utilizing the calibration curve for the membrane[1b], this value would indicate a molecular weight of 13,800 ±400 for the polymers (discounting the relative states of aggregation of proteins *vs.* melanoidins).

Results and Discussion

The isolation from cane final molasses of the fraction containing the polymers described in this paper was based on the rate of escape through a previously calibrated membrane of some of the principle simple constituents of cane final molasses. Approximately 90% of the amino-acids (as asparagine) and the monosaccharides (as D-glucose) had escaped in 24 hr; forty-eight hours were required for the outgoing of the same percentage of sucrose (Fig. 1). Inasmuch as the escaping polymers were expected to diffuse through the membrane at a rate significantly less than those of the simple molasses constituents, the dialysis with the continuous removal of the diffusates from the solvent outside of the membrane bag was allowed to proceed for 48 hr before the collection of the polymers was begun. The diffusates were then collected in fresh solvent which was allowed to remain in contact with the membrane for 96 hr. Paper chromatographic assay for the sugars in this molasses fraction is shown in Fig. 2a; the probable presence of sucrose and "browning" polymers along with traces of D-glucose and D-fructose was indicated.

The progress of the dialysis in the isolation of the polymers was followed in three ways, namely, chromatographically, by changes in solids concentrations, and colorimetrically. Chromatographic assays revealed that the simple carbohydrates had decreased in concentration to undetectable levels during the first 48-hr period (Fig. 2 a, b, c) and that solute diffusion through the membrane during the second 48-hr period was that of the polymers (Fig. 2 c, d, e). These conclusions were supported by the rate of solute escape based on the solids determinations (Fig. 2 C). Furthermore, the straightness of the line representing the second 48-hr period of these data (Fig. 2 C) implied a certain homogeneity in the polymer species and permitted an estimation of their molecular weight. The rate of decrease in colour was followed by the changes in optical densities at 420 and 490 mμ (Fig. 2 A and B). The slope of the line depicting the rate of colour change at 490 mμ during the second 48-hr period (Fig. 2 B) was identical to that representing the rate of solute diffusion (Fig. 2 C). These data indicated that the escaping coloured substances were the polymers.

The rates of escape of molecules through a membrane of uniform pore size may be expected in free diffusion to be proportional to the inverse cube root of their molecular weights. Recent studies[6] in the use of cellulosic membranes for the estimation of the molecular weight of intermediate sized proteins indicated that this proportionality did not hold; the shape of the molecule must be considered also. Their rates of diffusion depended also on such factors as the pH and ionic strength of the solvent and the distribution of the pore size of the membrane. As the limiting pore size of the membrane was approached the selectivity was far removed from that expected in free diffusion. The diffusion rate of the polymers herein described was well away from the point of total exclusion of the membrane[1b] and was near that of lysozyme (M.W. 14,000). Discounting the relative states of aggregation of proteins *vs.* melanoidins and recognising the limitations of employing the inverse cube root relationship, an estimation of the molecular weight of these polymers was made. This value was found to be 13,800 ±400.

The molasses polymers herein described were golden in colour; they possessed carbohydrate groups (Molisch positive). Two empirical formulas for the repeating units in these polymers were derived from their elemental analysis: $C_{14}H_{20}O_9N$ and $C_{38-39}H_{40-41}O_{18-19}N_2$. The second formula was preferred since it would be consistent with a unit containing three hexose and two 5-carbon amino-acid residues. The 5-carbon amino-acid is representative of those found in cane juice[7]. The repeating unit for the dialysed molasses polymers was $C_{17-19}H_{26-27}O_{10}N^{1a}$; these polymers were brown.

Summary

"Browning" polymers have been isolated from the diffusates of the dialysis of cane final molasses. The molecular weight of these polymers was estimated from membrane diffusion data to be about 14,000. An empirical formula for the repeating unit in the polymers, $C_{38-39}H_{40-41}O_{18-19}N_2$, was deduced from the elemental analysis.

[6] Craig: *J. Amer. Chem. Soc.*, 1955, **77**, 6620; 1956, **78**, 4171; 1957, **79**, 372*y*; Craig *et al.*: "Symposium on Protein Structure" (IUPAC meeting, Paris, 1957), Ed. A. Neuberger. (John Wiley & Sons, Inc., New York.) 1958, p. 104.

[7] Roberts and Martin: *Sugar*, 1956, **51**, (1), 32.

Trials with "Separan AP-30" at Central Guánica. R. RAMIREZ. *Paper presented to the Ann. Meeting, Asoc. Técn. Azuc. Puerto Rico*, 1959.—Experiments have been carried out with the object of improving clarifier performance at Central Guánica, the difficulties at this station having caused a reduction in milling rate. At first the "Separan", as a 0·17% solution in water, at 180°F, was added to the juice flowing to the clarifiers, the amount added being equivalent to 0·6 p.p.m. of reagent. However, even increasing the dosage to 2·0 p.p.m. produced no change in juice clarity, or mud density. This was attributed to agitation of the juice; so the "Separan" solution was added to the flash tank of the clarifier; the results with 0·6 p.p.m.–2·0 p.p.m. were better than before but not as good as had been hoped. A further improvement was found on adding the "Separan" as a 0·12% rather than a 0·17% solution. Following the report of MORON & KELLER[1], this concentration was further reduced to 0·05%, whereupon good results comparable to those quoted by MORON & KELLER were achieved. The juice clarity improved with increasing "Separan" addition, while the mud volume decreased. In one experiment, using 5 p.p.m. "Separan" the mud density was so high that water had to be added to make it flow. Best results were given with 2 p.p.m. "Separan", but the addition must be carefully controlled to ensure fluidity of the muds.

* * *

Cane cleaning at Central Cortada. H. A. WILLETT and F. J. THILLET. *Paper presented to the Ann. Meeting Asoc. Técn. Azuc. Puerto Rico*, 1959.—When field mechanization was adopted at Cortada in 1953 cane was not washed and the dry weather did not make cane cleaning necessary. In the rainy 1954 season, however, serious processing troubles and heavy wear of equipment caused by trash and dirt entering the factory necessitated installing a washer. Difficulties with this plant and its operation are described, both in this season and the next wet season—1958—when the washer had virtually to be redesigned and rebuilt.

* * *

Leaf pressure filters used at Villanueva. J. M. SANTIAGO. *Sugar y Azúcar*, 1960, **55**, (1), 35.—At the new factory, previously described[2], the clarifier muds are treated alternately in two Suchar "Fas-Flo" leaf filters. After each cycle, the feed is directed to the second filter while the first is drained, the drainings being passed to the other filter. The mud in the drained filter is sweetened-off by compressed air and steam and the muds washed out and disposed in the irrigation system. Total downtime, including filling time, is about 30 minutes.

On the use of ultrasonics in the struggle against scale formation in evaporators. M. L. VAISMAN, V. P. TROINO and V. M. PERTSEL'. *Sakhar. Prom.*, 1960, (1), 36–39.—Removal of evaporator scale by ultrasonic waves produced by magnetostriction is discussed and the principle of such an impulse generator as the "Crustex" type manufactured by H. N. Electrical Supplies Ltd.[3], is described. Tests have shown that a 3 mm layer of scale in a boiler became loose after 7 days' operation of the generator and partly fell away; within 3 weeks only a 0·1–0·2 mm layer remained, which did not increase in thickness. Similar satisfactory results have been achieved in scale removal from various pieces of boiler-house equipment and in melting of sugar (at 70°C ten times quicker than normally). The use of ultrasonics in filtration, nucleation in the vacuum pan, etc., is discussed.

* * *

For longer pump life—do not drown your stuffing box. N. O. KRISTY. *Sugar J.* (La.), 1960, **22**, (8), 18–19.—A warning against excess sealing and lubricating water supply to the stuffing boxes of pumps is given, as this results in rapid wear of the packing and shaft sleeve. Exclusion of grit from the packing and the methods of supplying water through an external system are discussed.

* * *

Continuous sugar centrifuge demonstrated. ANON. *S. African Sugar J.*, 1960, **44**, 31–33.—A demonstration was carried out of a Krauss-Maffei 4-stage pusher-type continuous centrifugal suited to raw sugar curing. The largest diameter is 33 in and the speed 800 r.p.m. Massecuite from a distributing cone passes to the first stage where molasses is separated. The sugar is pushed by a reciprocating piston to the second stage where it is washed, the third and fourth stages being drying zones. The feed range is controllable from 3 to 8 tons of crystal per hour. Results during the course of the season indicated that the sugar obtained was suitable for remelting but that further study was necessary before the sugar quality would be high enough for bagging.

* * *

Some notes on the settling of juices. W. S. GRAHAM and L. C. G. DOUWES DEKKER. *S. African Sugar J.*, 1960, **44**, 51–55.—Laboratory tests, based on the procedure of SCHMIDT[4], were carried out on juice samples from S.M.R.I. cane. The juice was cold-

[1] *I.S.J.*, 1959, **61**, 306.
[2] *I.S.J.*, 1960, **62**, 132.
[3] See *I.S.J.*, 1954, **56**, 22.
[4] See *I.S.J.*, 1954, **56**, 318.

limed with strong calcium saccharate to pH 8·5 and boiled for 2 min before settling at 95°C. It was found that a mixed juice sample kept at room temperature for up to 4 hr required more calcium saccharate to give the required pH, that the mud from this settled more slowly, while the final mud volume and juice clarity were greater. The settling rate, unaffected by mud particle concentration, increased with dilution of the juice, although changes in the Brix did not affect clarity. Up to 20% muds recirculation had no effect on the settling rate and the final mud volume was about the same as the sum of volumes of mud from fresh juice and recirculated mud. Vigorous agitation of the juice had no effect on settling. Tests with factory juices showed that hot liming to pH 8·0 increased the settling rate and reduced the mud volume compared with cold liming to pH 8·5, the hot-limed clarified juice being much more turbid than the cold-limed juice of similar pH value. Adding 10–20% by vol. of Oliver filtrate to the mixed juice increased the mud volume by an amount proportional to the amount of filtrate added, and decreased the settling rate, but gave a clearer juice. Settling characteristics different from the usual, shown by certain samples of juice, were attributed to a high Mg concentration. Treating mixed juice in a De Laval centrifugal separator before liming and settling reduced the amount of calcium saccharate required for pH 8·5 by about 10%, gave larger flocs, increased the settling rate slightly, gave a 15–20% lower mud volume, clearer clarified juice and removed mainly starch and insoluble silica.

* * *

New bulk sugar loading system in the Dominican Republic. ANON. *Sugar J.* (La.), 1960, **22,** (8), 24.—The installation at Rio Haina is described[1].

* * *

The presence of thermophilic and mesophilic micro-organisms in sugar and intermediate products. J. BRUIJN. *S. African Sugar J.*, 1960, **44,** 57–59.—A survey of bacterial infection of intermediate and final products was conducted at several factories over some months, and maximum and minimum values are tabulated for factories using sulphitation, defecation, carbonatation and refining with melt carbonatation. It was found that while heating did not remove many bacteria, settling and filtration were more effective. However, while the clarified juice contained few bacteria, the number increased at later stages, owing to air contamination, in open containers and on cooling. Yeasts and moulds are killed at every stage by heating, the mount of raw sugar being large, however, owing to air contamination and to the molasses film, which keeps the raw sugar damp. Thermophiles were only occasionally detected, very seldom in mill white and refined sugars. Air contamination in the bagging room was considerable.

* * *

Useful calculations. C. G. M. PERK. *S. African Sugar J.*, 1960, **44,** 59–63.—The Neuman, Schneider and Hulla-Suchomel formulae for massecuite yields are presented and their uses in boiling scheme calculations discussed. A *C*-massecuite exhaustion of less than 60% in Natal is attributed to too coarse a boiling, or a lack of crystal surface area. The use of Cobenze diagrams is also mentioned.

* * *

Unit load per cu. ft. of total roller volume. C. G. M. PERK. *S. African Sugar J.*, 1960, **44,** 63, 65.—For comparison of milling results from different factories, the factor, lb of fibre per cu.ft. *total* roller volume per hr, is recommended. Calculations were made of the total roller volume of the 22 tandems in Natal. From the average tonnage of fibre crushed per hr during an October period and the total roller volume, the unit load for the tandems was calculated. Comparison of these values with the % lost absolute juice over the same period shows that only those tandems with a unit load less than 50 lb fibre/hr/cu. ft. have been able to reduce the lost juice to less than 40%.

* * *

Prima-Sep provides new clarifier design. ANON. *Sugar y Azúcar*, 1960, **55,** (2), 41–42.—The "Prima-Sep" clarifier of Graver Water Conditioning Co. is described[2].

* * *

Formalin as a preservative for raw cane juice. B. G. KRISHNAMURTI. *Indian Sugar*, 1958, **9,** 435–443.—Comparative tests were carried out on the use of formalin (40% HCHO) and sodium hypochlorite solution (containing 0·54% available chlorine) as disinfectants, in which each was added to raw cane juice, which was then allowed to undergo spontaneous fermentation. The acidity and/or Brix or s.g. of the juice were determined periodically. The sodium hypochlorite up to 5·0 c.c. per 100 c.c. juice did not prevent a drop in pH due to bacterial action nor alcoholic fermentation by yeast, which, on the contrary, it seemed to encourage. The effect of the formalin increased with the dose, though with some juices even at 0·025 and 0·05 c.c. per 100 c.c. juice it prevented bacterial development and a drop in pH for 24–48 hr. However, heavily infected juice might require 0·2 c.c.; nevertheless this concentration did not inhibit inversion, although it was effective in preventing alcoholic and acid fermentation, the original Brix being maintained constant for several days. The formalin appeared to inhibit selectively the effect of the zymase, but did not affect the invertase. The formalin did not increase inversion, despite its acid reaction, except in the presence of yeast.

* * *

Corrosion control in the sugar industry. A. MAY. *S. African Sugar J.*, 1960, **44,** 111–113.—Corrosion prevention by suitable paints and good surface preparation are discussed. Tank lining, rust removal, and the use of plastic piping and fittings are also mentioned.

[1] See *I.S.J.*, 1959, **61,** 351.
[2] See *I.S.J.*, 1960, **62,** 79.

Massecuite stiffness indicator. T. FURUTERA and T. OKAMOTO. *Proc. Research Soc. Japan Refineries Tech.*, 1959, **8**, 1–5.—The indicator comprises a rotating paddle, inserted in the massecuite, which is driven at constant speed by a synchronous motor mounted in a frame supported at two points so that it can rotate through an angle of 230°. The resistance of the massecuite to the rotation of the paddle causes the frame to take up an inclination the angle of which is related to the stiffness of the massecuite. Recording of this inclination thus gives a record of the massecuite stiffness, and charts produced in this way have proved satisfactory for the controlling of pan boiling in the refinery.

* * *

Overall heat transfer coefficient of the calandria pan in the boiling of white sugar massecuite. H. OKITA. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1959, **8**, 6–16.—The overall heat transfer coefficient was measured from the heating surface, temperature difference between steam and massecuite and rate of heat flow as calculated from the amount of condensate produced per hour and the heat loss on condensing 1 kilo of steam (the last by subtracting the enthalpy of condensate from that of steam). Under conditions of white sugar boiling the overall coefficient was within the range 200–900 kcal/sq.m./hr/°C where the temperature difference was 44–54°C, and the mean coefficient throughout the boiling was about 500 kcal/sq.m./hr/°C. The effect of a number of factors on the coefficient was studied and the results recorded in tables and graphs: the overall coefficient increased with massecuite Brix in spite of the high viscosity; the coefficient was inversely proportional to the fourth root of viscosity ($\mu^{\frac{1}{4}}$); the coefficient rose and then fell with increasing crystal content on massecuite solids, the maximum value occurring at about 50% crystals; when massecuite level was raised above about 1 metre over the top tube sheet the coefficient dropped rapidly because of poor circulation; and the coefficient was found to be higher to some extent with large crystal massecuites than with small crystal massecuites. The viscosity of massecuites, measured with a rotary viscometer, was found to increase greatly with high crystal content. Temperature measurements in the boiling of soft white superior sugar showed that the massecuite at 9 cm above the top tube did not reach the boiling point corresponding to the hydrostatic head of 1 metre.

* * *

Control of pan drinking by nomograph in the case of mixed boiling. S. MOCHIZUKI. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1959, **8**, 17–21.—Nomographs have been constructed on the basis of two equations representing the solid balance and colour (or purity) balance respectively:

$$\Sigma a_i x_i = C$$
$$\Sigma a_i b_i x_i = O$$

where a_i = Brix density, $b_i = (P_i - P_o)$ = difference from the fixed value, C = solid weight of massecuite, x_i = volume of fed liquor, P_i colour value or purity, $P_o = (f + \beta)$ = fixed value of colour value or purity, f = control value of the massecuite and β = colour increase or purity drop (+ or — respectively). Examples of the nomographs for two and three-component systems are presented and their use illustrated by graphs of massecuite colour value using and not using such nomographs.

* * *

Property change of "Amberlite IRA-401" (C1) during long term operation in a sugar refinery. K. SUZUKI. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1959, **8**, 22–29.—Examination of used "Amberlite IRA-410" resin showed that there was 10% degradation of polymer structure after 240 cycles, and the absolute density of the resin had increased by irreversible adsorption of impurities, i.e. "fouling." In addition, water adsorption was greater but the reswelling power of dried resin decreased, and the shrinking ratio of the resin in an electrolyte solution also decreased; it is concluded that these changes depend less on the concentration of the exchange radical than on the polymer structure degradation and the adsorbed impurities. Salt splitting anion capacity was reduced by about 40% after 240 cycles, anion exchange capacity by 60%, and it was found that, in every cycle, about 30% of the attacked strong basic groups always remained as weak basic groups. Apparent electrolytic dissociation indices (pK values) were calculated to be 3 for unused resin and 5 (strong bases) and 8 (weak bases) for used resin. Decolorization capacity was recovered by regeneration with NaOCl solution but the effluent pH was considerably lowered when the resin was first used after regeneration owing to elution of HCl from the resin; this could be prevented by washing the resin with 3·5% soda ash solution at 40°C after regeneration with NaOCl. In spite of the chemical and physical changes observed, the decolorization capacity was not greatly decreased. Consequently it is hard to find the exact relations between them, although it may be concluded that the main cause of the decrease of decolorization capacity is the decrease of adsorption surface area by fouling, so that the conditions of resin fouling and its physical strength will govern its effective life.

* * *

Fluctuation of pH and effect of automatic control of pH in the carbonatation process. J. YAMAGA. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1959, **8**, 58–62.—A system has been tested since June 1958 whereby the pH of juice leaving the carbonatation tank is measured and the valve of the flue gas inlet adjusted to maintain a constant preset pH. A Saunders diaphragm valve was used which prevents soot accumulation and increase of friction. The pH deviation is less than two-thirds of that with manual control. Since the relation between final pH and residual lime salts is parabolic, close control of pH can achieve minimum lime salts. Further, the control method is effective for colour removal and filtration.

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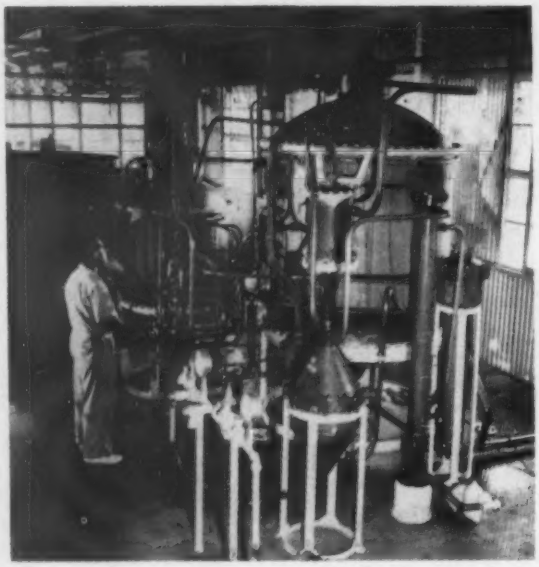

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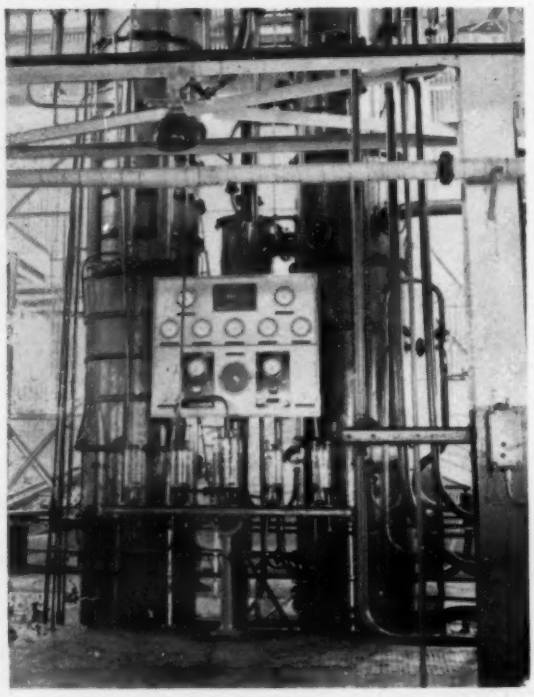

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BEET FACTORY NOTES

Device for adding disinfectants to diffusers. K. PIASECKI and K. POGRANICZNY. *Gaz. Cukr.*, 1960, **62,** 9.—This comprises two interconnected vessels into which formalin and diffusion water are pumped, the (upper) formalin vessel being calibrated to ensure correct proportioning. The line connecting the two vessels is opened and the two discharged into the line feeding the diffuser(s), the bottom diffusion water tank then being emptied.

* * *

Pneumatic transport of defecation mud. A. GRABSKI. *Gaz. Cukr.*, 1960, **62,** 9–10.—A pneumatic pipeline system for transporting diluted muds of about 55% dry solids straight to the fields is described with a diagram.

* * *

Prerequisites for 1st carbonatation juice in rotary filters. W. EWERS. *Zuckererzeugung*, 1960, **4,** 20–23.—On the basis of the literature and factory experiences at Haldensleben, the factors affecting juice filtration and clarification are enumerated, covering diffusion pH and temperature, mud return to pre-defecation and conditions of main liming and 1st carbonatation.

* * *

Dependence of the purity of sugar crystals on the purity of sugar juices and syrups. L. TEREK. *Tehnika*, 1956, **10,** (7), 1069–1071; through *S.I.A.*, 1960, **22,** Abs. 40.—Equations are quoted to indicate the concentrations of sugars and non-sugars in solutions as crystallization progresses. A graph is given of the ratio da/dC against time, where da is the quantity of adsorbed and included non-sugars, and dC is the amount of sugar crystallized, and this indicates a "point of inflexion", *cf*, where the amount of non-sugars in the crystals suddenly rises sharply. The shape of the graph is confirmed by results obtained at the Branjin Vrh factory of the "Belje" combine (Yugoslavia) during the 1955/56 season, and is used as a measure of the relation between the crystal purity and the syrup purity during the course of crystallization. This relationship is used to determine the true purity of final molasses.

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Removal of non-sugars in diffusion juice with ion-exchangers. S. POPOV. *Legkaya Prom.*, 1956, **5,** (10), 46–47; through *S.I.A.*, 1960, **22,** Abs. 48.—Diffusion juice, at 75–80°C and pH 8·5–9, is passed through cation-exchange resin 'C300' and anion-exchange resin 'IA 17'. The CaO level of the juice is thereby reduced from 22 mg to 3–9 mg of CaO per litre.

* * *

Economical optimal juice extraction. G. OPLATKA. *Zeitsch. Zuckerind.*, 1960, **85,** 61–66.—Optimal juice extraction is discussed mathematically from both technical and economics viewpoints. Equations are derived for the various parameters, e.g. juice draught, retention time, sugar losses and the capacity of the diffuser. The costs of producing 1 kg of sugar from beet are calculated, and the value is used as a criterion for comparison of diffusion systems. However, is is pointed out that there are numerous other factors to consider in the evaluation of any one system. Calculations are given for a particular case as an example.

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Automation of production and of operational control of technical processes in the Polish sugar industry. J. BROWKIN. *Wissenschaftliche Zeitschr. der Karl Marx Univ. Leipzig. Math.-Naturwiss. Reihe*, 1955–6, **5,** 347–354; through *S.I.A.*, 1960, **22,** Abs. 108.—Various automatic control devices are described and illustrated. These include: (1) The Godwod lime dosing apparatus in which milk-of lime passes through one tank where a constant level is maintained by an overflow pipe, and diffusion juice through another tank which has two outlets, one with a hand-operated slide valve control and one with a slide valve controlled through a level arm by a float in the milk-of-lime tank; a float in the juice tank controls a slide valve on the delivery outlet of the milk-of-lime tank. The densities of each liquid thus mutally control the proportions of the flow. (2) The carbon dioxide supply to the 1st saturation tank is controlled by an alkali meter constructed on the principle of a Wheatstone bridge, with an induction galvanometer to give a visible reading on an illuminated scale. (3) The temperature of each diffuser in a battery is measured by a resistance thermometer and all are shown simultaneously on an indicator panel. (4) Sugar contents in beets, cossettes, diffusion water, thin and thick juices, and muds are transmitted from the control laboratory to the central indicator panel as light signals. The centralized information also includes quantities (weights, volumes) in process, various temperature controls and water or juice levels in different tanks. A combined recorder for such data was devised in 1939 and was named the "Tempograph," and is now in general use in Polish factories. The recording system is briefly described and illustrated.

* * *

The wilting of sugar beet. S. VAJNA. *Zucker*, 1960, **13,** 123–133.—Increased use of mechanical harvesting has led to an increase in the extent of wilting, as the beet are stacked for longer periods in small piles with large exposed surfaces. Formulae are presented for calculation of the moisture loss, based on such factors as temperature and air flow. The process of wilting and its effect on sugar loss and resistance to bacterial infection are described. To prevent wilting the beet should be stacked in small clamps straight after lifting, and re-stacked in larger piles within 1–2 days; or the sides of the small clamps must be covered and made absolutely air-tight.

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Modernization of normal settlers for flume and wash waters[1]. V. N. PELETMINSKII. *Sakhar Prom.*, 1960, (2), 11–13.—As factory capacities are raised and/or

[1] See also *I.S.J.*, 1959, **61,** 372.

very dirty beet are handled, so must the capacity of the clarifiers for the flume and wash waters be increased. The costs of increasing the number of compartments in a standard type of settler can be cut by increasing the effective surface area. It is calculated that the depth of a normal clarifier of approximately 9 m radius at the overflow would have to be increased from 1·25 m to 5·7 m if full use were to be made of the settling surface, instead of only 22%. Instead of deepening to such an extent, it would be simpler to increase the length of the purified water withdrawal pipe, which would also prevent discharge of mud particles with the water. It is recommended that two pipes of 125–150 mm dia. be installed in each section, 300–350 mm below the upper edge and radiating from the centre, and perforated on the under side with 29–33 mm holes at every 200 mm pipe length. (The dia. of the holes will depend on pipe dia. and can be calculated as shown elsewhere[1].) A 1 m high vertical screen at the water feed port at the centre of the settling tank would reduce the volume of unsettled mud at the centre and would allow any floating foreign bodies to be removed from the water. At Krasnoyaruzhsk factory continuous mud removal is effected by a siphoning arrangement including a vertical pipe ending 100–120 mm above the clarifier bottom, a cylinder and a horizontal pipe feeding into the mud drain pipe. This achieves 80% mud removal, but complete removal is prevented because of the gentle slope of the tank bottom. Consequently, the clarifier has to be liquidated every five days.

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Tests on the application of hydrocyclones at Novo-Troitsk factory. Z. D. ZHURAVLEVA, F. N. DOBRONRAVOV and R. B. LOZINSKII. *Sakhar. Prom.*, 1960, (2), 14–20.—Tests were carried out during the 1958/59 campaign on treatment of milk-of-lime and 1st and 2nd carbonatation juices. The juice was subject to both single- and two-stage treatment. In the latter case, the juice was passed through clarifiers to the first hydrocyclone, the over-flow then passing to a second hydrocyclone and thence to the 1st or 2nd carbonatation filter-presses. The under-flow from both hydrocyclones passed to their respective tanks, then to the muddy juice drain. The juice treated in the tests was obtained from beet stored for a long period and having a high content of deteriorated roots. The temperature of the juice varied from 88 to 90°C. The best effects in the treatment of 1st carbonatation juice were achieved at a feed pressure of 3–5 atm, a 17° cone angle, and cylinder section diameter of 150, 100 and 75 mm. Maximum mud removal in single-stage treatment was 58·7% at 5 atm. feed pressure, bottom nozzle dia. of 6–8 mm, cone angle of 17°, cylinder diameter of 75 mm and an over-flow pipe dia. of 40 mm. In two-stage treatment, the maximum effect was 77·2% mud removal in a 100 and 75 mm dia. cylinder at 4 atm. feed pressure, with other dimensions as above in the single-stage treatment. The daily output of the 100-mm dia. hydrocyclones was 180-200 m. tons, that of the 75-mm dia. hydrocyclones 160-180 m. tons. In 2nd carbonatation juice treatment the maximum amount of mud removed was 90·3% in two-stage treatment in a 75-mm dia. followed by a 50-mm dia. hydrocyclone, both having a 17° cone angle, 6–8 mm dia. discharge nozzle, and operating at 3–4 atm feed pressure, the overflow diameter being 40 and 45 mm respectively. Hydrocyclones of 84 and 100 mm dia. were used for milk-of-lime treatment. The cone angle was 20°, discharge nozzle dia. 8 mm, feed nozzle 22 and 25 mm respectively, and overflow pipe dia. 20 and 32 mm respectively. Feed pressure was 2 atm. In the larger hydrocyclone 97·8% sand and undissolved lime particles were removed, with 80–85% purified milk-of-lime and 15–20% thickened mud on original milk-of-lime. At 2·5% lime on beet, the 100-mm. dia hydrocyclone has a capacity corresponding to 400–450 m.tons of beet per day. A flow diagram for a proposed hydrocyclone scheme for 1st and 2nd carbonatation juice is presented.

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The effect of sodium triphosphate in 2nd carbonatation juice on the losses of sugar in molasses. A. D. GOLUBEVA. *Sakhar. Prom.*, 1960, (2), 20–22.—Laboratory tests were conducted on 2nd carbonatation juice treatment with sodium triphosphate; the juice, (in one series from stored beet, in the other two series samples of defecation juice from two different factories) was saturated to 'optimal alkalinity' at 85–87°C, filtered, and gassed to 2nd carbonatation alkalinity at 90°C. The sodium phosphate was added at from 10 to 110% of the equivalent on CaO content; in some cases the juice was sulphitated to pH 7·2. In all cases the juice was evaporated to 65–70°Bx; double and triple crystallization was carried out, so that the purity of the molasses from double treatment was 58–65, and from the three-stage treatment 62–65 and 65–71. Molasses exhaustion in a thermostat and calculation of the standard purity were carried out by the method of P. M. SILIN. The molasses dry solids contents were determined by direct refractometry, drying or by the method of normal weight. Differences were found between the dry solids values, that between the refractometric dry solids and the value from the drying method decreasing with increase in the phosphate dose. The figures were practically the same for the two samples of defecation juice, while the standard purity determined from the dry solids by drying was lower than from the refractometric dry solids in the case of stored beet. However, this difference tended to disappear with increase in the phosphate dose. There was a slight drop in the saturation coefficient of the final molasses. Regarding juice from the stored beet, the molasses saturation coefficient fell sharply up to 30% equivalent phosphate, with a drop in sugar losses and improvement in boiling, crystallization and spinning of the massecuites of all products. From the liberation of CO_2 from the juice after phosphate addition, it is assumed that the phosphate destroys the lime salts of the carbamic acids, formed when the amino acids content is increased. (In an editorial note, the liberation of CO_2 when the phosphate is added is considered inexplicable.)

Modifying the head section of a rotary diffuser. G. A. MIKULA and V. A. KAMENETSKII. *Sakhar. Prom.*, 1960, (2), 23–24.—The fixed woven screens of 2·5 × 60 mm mesh in the head of a single-scroll Mandryko diffuser were replaced with 5-mm sheet steel pressed screens of 8 × 8 mm mesh, which rotate with the scroll, together with other modifications; thus, such operational defects as incomplete juice extraction, blockage of the head with juice-cossette mixture, and consequent blockage of the juice recirculation tank, pulp trap, and juice heater tubes with pulp, have been remedied, and the capacity of the diffuser has been increased.

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Determination of lime consumption in juice purification. S. F. SKORBILIN. *Sakhar. Prom.*, 1960, (2), 24–25.—The lime consumption in juice purification where 1st carbonatation juice is returned to pre-liming can be calculated from the following formula:

$$x = D\,\frac{va(b-g)-ga(b-v)}{100(g-a)(b-v)}\,\%\ \mathrm{CaO}$$

where x = lime consumed on weight of beet, D = amount of raw juice % on beet, v = prelimed juice alkalinity, a = lime content (CaO) of milk-of-lime, b = alkalinity of unfiltered 1st carbonatation juice returned to pre-liming, and g = defecation juice alkalinity. If no juice is returned to pre-liming, but milk-of-lime used instead, the amount of lime consumed is calculated from

$$\mathrm{CaO} = \frac{Dag}{100(a-g)}\,\%.$$

* * *

A continuous diffuser. Z. D. FEL'DSHON. *Sakhar Prom.*, 1960, (2), 25–28.—An illustrated description is given of a U-shaped diffuser having two vertical pipes connected by a horizontal pipe. Parallel valves, connected by a shaft, are located in the vertical pipes and the cossette entry pipe from the scalder is located just above one of these valves. The cossette feed valve and the shaft are connected by a system of bevel gears so that when the cossette valve is open, the other two are shut and vice versa. A reciprocating piston in the vertical pipe is linked with the valves so that on its upward stroke it draws cossettes into the vertical pipe through the open cossette valve, which then shuts so that the piston, on its downward stroke, pushes them along the diffuser, displacing an equal volume of exhausted cossettes at the end of the other vertical pipe. When the piston completes its downward stroke, the cossette valve opens and the others close. At the same time two magnets actuate a condenser water valve, at a point about halfway up the opposite pipe from that housing the piston, and a valve in a line feeding juice displaced by the water to a circulation tank. through screens, which are cleaned by rakes. The juice is pumped from the tank through a heater to the scalding trough, from which it is finally discharged to the main tank. The main pipes are separated by disc screens, which rotate through an angle of 90° (parallel to the flow) when the cossettes are fed into the diffuser, and again through 90° to divide the diffuser into separate sections. These screens are synchronised with the cossette and juice draw-off controls. Tests with a pilot-scale diffuser (8·75 hectolitres effective capacity) have given satisfactory results, the losses over 5 days being 0·46%, compared with 0·47% in a battery diffuser, at a juice draught of 108–112%. Juice density was satisfactory at 13–17% dry solids. Retention time was 60 min. The piston valve has served as a basis for Grebenyuk's diffuser design[1].

* * *

Automatic DS-800 scales for beet weighing. V. N. TRET'YAKOV. *Sakhar. Prom.*, 1960, (2), 37–38.—Details are given of an electric-powered automatic weigher of Soviet design, which has been installed in Karabulaksk factory. A number of defects were found during operation, but these have been remedied and the scales are recommended for a factory with a capacity of 2500 tons of beet per day.

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Performance of a continuous RT rotary diffuser at Turbovsk sugar factory. A. A. SOKOLOVSKII, B. I. BREZINSKII and V. A. DANIL'TSEV. *Sakhar. Prom.*, 1960, (2), 40–43.—A double-scroll RT diffuser of 1500 tons beet/day capacity was installed in 1958, and performance data and a diagram of the diffusion scheme at Turbovsk are presented. From 18th September to 20th December average losses were 0·41% at about 112% draught. Juice Brix was about 15°. Foam formation was attributed to processing of unripe beet at the start of the campaign and to nonstop operation of the circulation pumps. When half of the beet knives were taken out of operation, the cossette quality fell, with a mush content of 10%. Washing the screens with exhaust steam was unsuccessful, as the holes of the screens became blocked with mashed pulp and the mechanical brushes and pulp trap were not effective. The steam was therefore replaced with hot water. Ten litres of formalin were added every 2 hr. A sulphitation tower was installed to reduce the pH of the condenser water and so prevent pectins passing into the juice. The quality of the raw juice has been found to be unsatisfactory, with up to 1% colloid content on beet and about 2% pulp. The sugar losses in molasses was 2·35% on beet compared with 1·88% from a Robert battery, and is attributed to the high colloid, ash and pulp content. To combat this, a second beet washer is recommended, another pulp trap (modified), more powerful pulp presses, formalin dosing as recommended by TSINS, increasing the circulating pumps capacity, installing a device in the head for screen cleaning during operation, synchronising the work of the beet knives and the diffuser, and installing control and measuring instruments.

[1] See *I.S.J.*, 1960, **62**, 138.

Experience in operation of the bagging station at Moronovsk sugar factory. M. I. BINDMAN. *Sakhar. Prom.*, 1960, (2), 44–45.—Details are given of the semi-automatic line for weighing, filling, and sewing the 50-kg sacks. Modifications of the line have enabled the number of operators to be cut from 16 to 6.

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Softening thin juice with cation exchangers. II. Bases for the calculation of a softening plant. J. BURIÁNEK and F. DURDÍK. *Listy Cukr.*, 1960, **76**, 38–41.—The effective capacity (kg CaO/cu.m.), juice treatment time cycle, and ratio—juice cycle:regeneration time—were determined at certain specific loadings for S and 'Lewatit S-100' polystyrene cation exchangers and for FNU and FNA cation exchangers. The tabulated data are used as criteria for the most economical softening plant for treatment of 450 litres/hr of juice, equivalent to 100 tons of beet per day. The two relations which must apply are: (1) (the number of filters used per cycle × effective capacity of one filter), which must be equal to or exceed (volume of juice treated per hr/permissible specific loading); and (2) (the number of filters used per cycle/number of filters non-operative or being regenerated), which must be less than or equal to (the time of one cycle/time required to regenerate during one cycle). From the economics viewpoint the polystyrene exchange resins are preferable to the F-type.

* * *

Experience on the continuous diffusion process (Buckau-Wolf type). H. KONISHI. *Proc. Research. Soc. Japan Sugar Refineries Tech.*, 1959, **8**, 101–111.—A description is given of the 1200-tons beet diffuser installed at Kitami factory in 1956, together with tabulated performance data, also recorded in graph form.

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Economics of sugar production. R. H. COTTRELL. *Sugar J.* (La.), 1960, **22**, (9), 7–14.—See *I.S.J.*, 1959, **61**, 338.

* * *

The spray condenser in the sugar industry. H. BALLEYER. *Zuckererzeugung*, 1960, **4**, 82–83.—The installation of spray condensers in the pan station is advocated because of their simple construction and low initial and running costs. The principle disadvantage is the small capacity, so that evacuation of a pan takes a long time; various means of overcoming this are suggested.

* * *

New experiments on the properties of lime of different degrees of burning. G. POHL. *Zucker*, 1960, **13**, 168–175.—Tests carried out on the effect of difference in the degrees of burning (characterized here by bulk density) of two or more types of limestone on the quality of the lime mixtures are discussed. The results show that it is not dangerous to mix different types of limestone, providing the types are not extreme, e.g. soft and hard stone, but that the narrower the range of the burning degree the better.

Stone-catching in theory and practice. S. WINKLER. *Zucker*, 1960, **13**, 99–104.—The theories of settling are discussed and a graph presented of settling rates for beet, stones, clinker, etc. in relation to their average diameters. A stone-catcher installed at Gross-Twülpstedt factory and manufactured by Bammann & Schreiber is described with diagrams. It comprises a 2-m length of square-section steel flume which narrows by means of 80-mm high steps on each side of the bottom towards a 250 × 400 mm opening, through which the heavier stones fall into the buckets of an elevator. A 0·15 m/sec stream of splash water flows at 900 litres/min upwards through the opening and causes turbulence at its junction with the flume water. This turbulence carries the beet past the stone discharge. A slide gate valve located before the stone-catcher moves up and down 100 mm 8 times a min and regulates beet flow. This is controlled from the beet-washer, so that the hopper above the slicers is evenly loaded at all times. 95% of the stones larger than 3 cm are removed, smaller ones being removed by the stone-catcher of the beet-washers. A grid can be placed over the catcher, and wash-water fed at 0·15 m/sec to raise the pieces of beet and tails smaller than 3·5 cm. Sand and gravel are removed by sieve.

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Programme indicator for diffusion temperature. J. BROWKIN. *Gaz. Cukr.*, 1960, **62**, 36–40.—Details and diagrams are given of an apparatus designed to help the operators in charge of the cells of a battery diffuser by indicating the average temperature which should be maintained in each cell, based on the temperature to be maintained in the head cell. The indicator comprises a metal drum with certain predetermined temperature values stencilled on its side, which is mounted on the same axis as a ratchet wheel. The ratchet wheel is held in position by a pawl, connected in turn to an electric impulse receiver. When an impulse is generated, the pawl is released sufficiently long enough to fall back into place at the next tooth. A second pawl placed at right-angles to the first pawl prevents the wheel spinning freely. The impulse is given by a generator actuated when the juice valve of each cell is opened, the temperature appropriate to the next position of the cell in the battery then appearing on the indicator. The indicators can be used in conjuntion with a central panel, connected to resistance thermometers, and with a central indicator showing the required temperatures in each cell, and the number of cells in operation.

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Comparison of filtration and centrifugal decantation. II. A. PARATELLA. *Ind. Sacc. Ital.*, 1960, **53**, 9–18.—The dilatometric behaviour and specific resistance of a solid porous bed are considered theoretically for conditions of varying working pressure; in this way a comparison can be made with the centrifugal process, and the author derives a ratio between the times for these two processes as a function of the motive forces and the structural and operational parameters of the apparatus.

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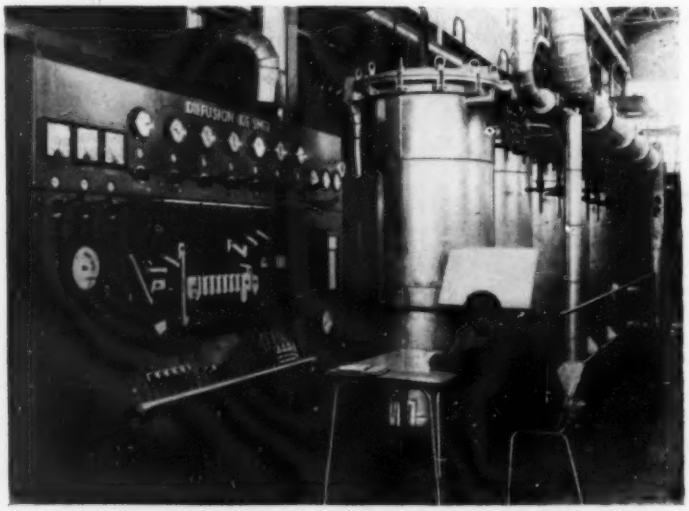

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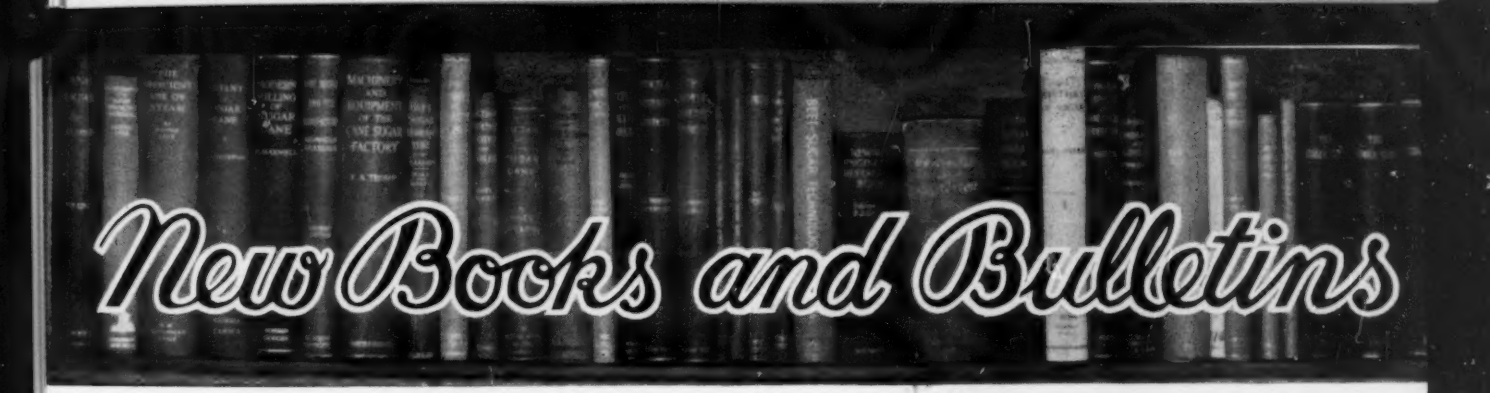

Mechanization of the Cultivation and Harvesting of Sugar Beet. M. I. STEPANOV. 54 pp, 26 illustrations; 8½ × 11 in. (United Nations Economic Commission for Europe, Geneva; 59.11.E/Mim. 2.) 1959. Price: $0.40; 3s. 0d.

This mimeographic report, which is the product of a Working Party set up in 1954, covers considerably more ground than the title implies for it opens with a general review of the varied soils and climate of the European countries in which sugar beet is grown, conditions which affect the preparatory processes and the implements used to prepare a satisfactory seed bed, including those used for manure and fertilizer distribution.

The chapter on sowing draws comparisons between cross-blocking and normal row sowing, and discusses the many problems affecting drill design, arising from down-the-row spacing and the introduction of monogerm seed.

The many forms of harvesters designed to top, lift, clean and load the beet are discussed and a final summary suggests that the main future tasks of mechanization will be the further elimination of labour through efficient stand-reducers and the increased efficiency of harvesters in topping and cleaning, particularly in difficult conditions of soil and weather.

H. M.-L.

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Manual on Economic Development Projects. ANON. 242 pp; 8¼ × 10¾ in. (United Nations, New York, U.S.A.) 1958. Price: $3.00; 22s. 6d.

This volume (Sales Ref. No. 58.II.G.5) is a United Nations document referring to projects defined as "the compilation of data which will enable an appraisal to be made of the economic advantages and disadvantages attendant upon the allocation of a country's resources to the production of specific goods or services." It endeavours to explain what is meant by these "economic advantages and disadvantages," what data can be used to determine them, and the methods whereby such data can be obtained and systematized. The Manual is a co-operative product of the U.N. Technical Assistance Administration and the Economic Commission for Latin America.

A feature is the use of case studies to illustrate the first parts of such explanations which are divided into a series of chapters on problems and general concepts, study of the market, project engineering, size and location of projects, investments in the project, budget for income and expenditure, financing and organization, project evaluation, financial equivalences, pricing and indirect effects, and criteria relating to the productivity of a single resource and of the input complex and combined criteria. Among these case studies are a number of aspects concerning the establishment of a beet sugar factory, and describing the analysis of tenders for equipment of the factory, examination of the raw material supply, development of a work schedule, size and location of the factory, calculation of the investment, income and expenditure budgets involved. For authorities concerned with the possible establishment of beet sugar production this manual would undoubtedly be valuable for these case studies alone.

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The Australian Sugar Year Book, 1960. 552 pp; 7¼ × 9¾ in. (Strand Press Pty. Ltd., 236 Elizabeth Street, Brisbane, Queensland, Australia.) 1960. Price: 30s 0d.

The latest of the series of Australian yearbooks has much in common with previous editions, a point of difference being the omission of the messages from Commonwealth and Queensland Ministers, while the former "Sugar Year Newsreel" starts the new volume, renamed "Sugar Year Digest." Articles describe the negotiations concerning the Commonwealth Sugar Agreement price for 1960, as well as two important new developments—the restriction of cane growing because of overproduction, and the export of Australian mill machinery to South Africa. Several facets of cane agriculture are discussed by the Director and staff of the Bureau of Sugar Experiment Stations, while the affairs of a number of organizations—Central Cane Prices Board, Queensland Society of Sugar Technologists, etc.—through the year are featured. The Sugar Statistics section is brought up to date, while the Australian Sugar Mills and Districts receive their usual detailed treatment, again accupying the major portion of the yearbook.

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Molasses in Compound Feed for Cattle, Swine and Poultry. J. G. J. VAN GINNEKEN. 18 pp; 5½ × 8¼ in. (Schuurmans & van Ginneken, 286 Herengracht, Amsterdam C., Holland.) 1958.

The characteristics of molasses from cane and beet are briefly described, and the U.S. Dept. of Agriculture quoted on the nutritive value of molasses as three quarters of that of yellow corn No. 3. The literature regarding the levels of molasses which should be incorporated in animal diets is referred to, and a discussion given of the requirements of a molasses mixing installation, reference being made to the equipment developed by the publishers.

Determination of the reactivity of burnt lime. G., RADERMACHER. *Zucker*, 1960, **13**, 64–67.—The wet slaking, conductivity and coarse grain titration methods of determining burnt lime reactivity are described and the results obtained by these means are discussed. For comparison, certain modifications should be made to the pieces of apparatus: an oven is required for the wet slaking method to give the apparatus, slaking water and lime the same initial temperature, and the coarse grain titration should be made automatic by pH control and installing a recorder. The conductivity method is not considered suitable for factory control, as the titration method is equally accurate.

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The solubility of calcium oxalate in sugar juices. M. ROCHE. *Ind. Alim. Agric.*, 1959, **76**, 949–953.—Experiments on calcium oxalate solubility in sugar solutions were carried out by adding 5 cc of an oxalic acid solution (5 g/litre) to a 500-cc sugar solution, followed by addition of 12 cc lime water (sufficient to neutralize 10 cc of the oxalic acid). After precipitation is completed, the solution is filtered and the calcium oxalate collected on a sintered glass filter, washed and dissolved in hot HCl. The oxalic acid contained in the HCl is then titrated with permanganate. The solubility is calculated from the difference between the amount of oxalic acid initially added to the sugar solution (checked by permanganate titration) and that in the precipitate. Accuracy is of the order of 1 mg/litre. For the sake of accuracy, the turbidity caused by the precipitation of the Ca oxalate is determined nephelometrically with a blue filter. The rate of precipitation from water solution increased with increase of temperature (from 20 to 60°), although this had no effect on the solubility, which was 10·5 mg/litre after 30 hr. Sucrose reduced solubility after 8 hr at 20°C to 8 mg/litre at 5% concentration and 6 mg/litre at 15%, while KCl at 0·02% concentration almost doubled the solubility, reaching 20 mg/litre after 2 hr. Corresponding figures for 0·04% and 0·06% KCl were 21 and 19 mg/litre. NaCl had practically no effect at 0·02% concentration. In the presence of 0·02% KCl, sucrose still reduced the solubility to 14 mg/litre for 5% and 10% and to 10 mg/litre for 20% and 50% sucrose, i.e. not below the solubility of the oxalate in pure water. Increasing the KCl to 0·04% did not affect the solubility in 50% sucrose solutions. Sodium tripolyphosphate at 4 mg/litre and 80°C increased the initial solubility to a greater extent than did the KCl, while subsequent precipitation is much slower and is caused by slow decomposition of the polyphosphate at 80°C. Thus the use of polyphosphate is recommended for retarding oxalate scale deposition. It should be introduced only in the last evaporator effect, however, as it is destroyed quickly at 100°C.

* * *

Microscopic determination of mud particles by different methods of 1st carbonatation. R. OSVALD. *Listy Cukr.*, 1959, **75**, 276–279.—Laboratory tests were carried out, in which raw juice was purified by different methods with a constant amount of lime used in defecation. The Brieghel-Müller filtration coefficient, F_k, settling rate and muds volume were determined and correlated with the structure and size of the mud aggregates examined with the aid of photomicrographs, taken under natural, induced and polarized light. It was found that the homogeneity and extent of coagulation of the mud particles, as well as the degree of dehydration of the colloids and extent to which these are enveloped in $CaCO_3$ crystals are the primary factors affecting filtrability of 1st carbonatation juice.

* * *

Organic acids in beets and juices. II. Determination of volatile acids by distillation. H. E. WALLENSTEIN and K. BOHN. *Zeitsch. Zuckerind.*, 1960, **85**, 21–24.—Methods of determining the volatile acids (formic, acetic and butyric acids) in beet and juices by steam distillation or distilling from aqueous solutions are discussed. Some distillation constants are compared, as are results of some tests carried out by the authors, which are unsatisfactory because of the considerable fluctuations in the percentages of acids recovered. The effect of other substances on the results, even during the actual distillation, is noted. A method is described in which about 1·5 litres of raw juice (or press juice, thick juice or molasses, all diluted to 10°–15°Bx) is mixed with "KPS 200" ion exchange resin in H^+ form until the pH drops to 3·0. The juice is filtered through asbestos wool, and 1100 ml of the filtrate passed through a cation exchange column and a column of "L 150" anion exchanger on the OH^- cycle. The columns are then washed with about 2 litres of water until completely sugar-free (α-naphthol test) and the eluate from the anion exchange and the wash water tested for break-through of free acids with N/10 NaOH using phenolphthalein indicator. The cation exchanger is regenerated with 2 N HCl (5–7 litres regenerant to 1 litre of resin). The anion exchanger is eluted with 400 ml N NaOH, then treated with 5 litres of 2N NaOH per litre of resin. Distillation may be carried out either by adding 100 ml eluate to a 250 ml flask, acidifying with phosphoric acid to pH 3, or by adding 100 ml to a 100/110

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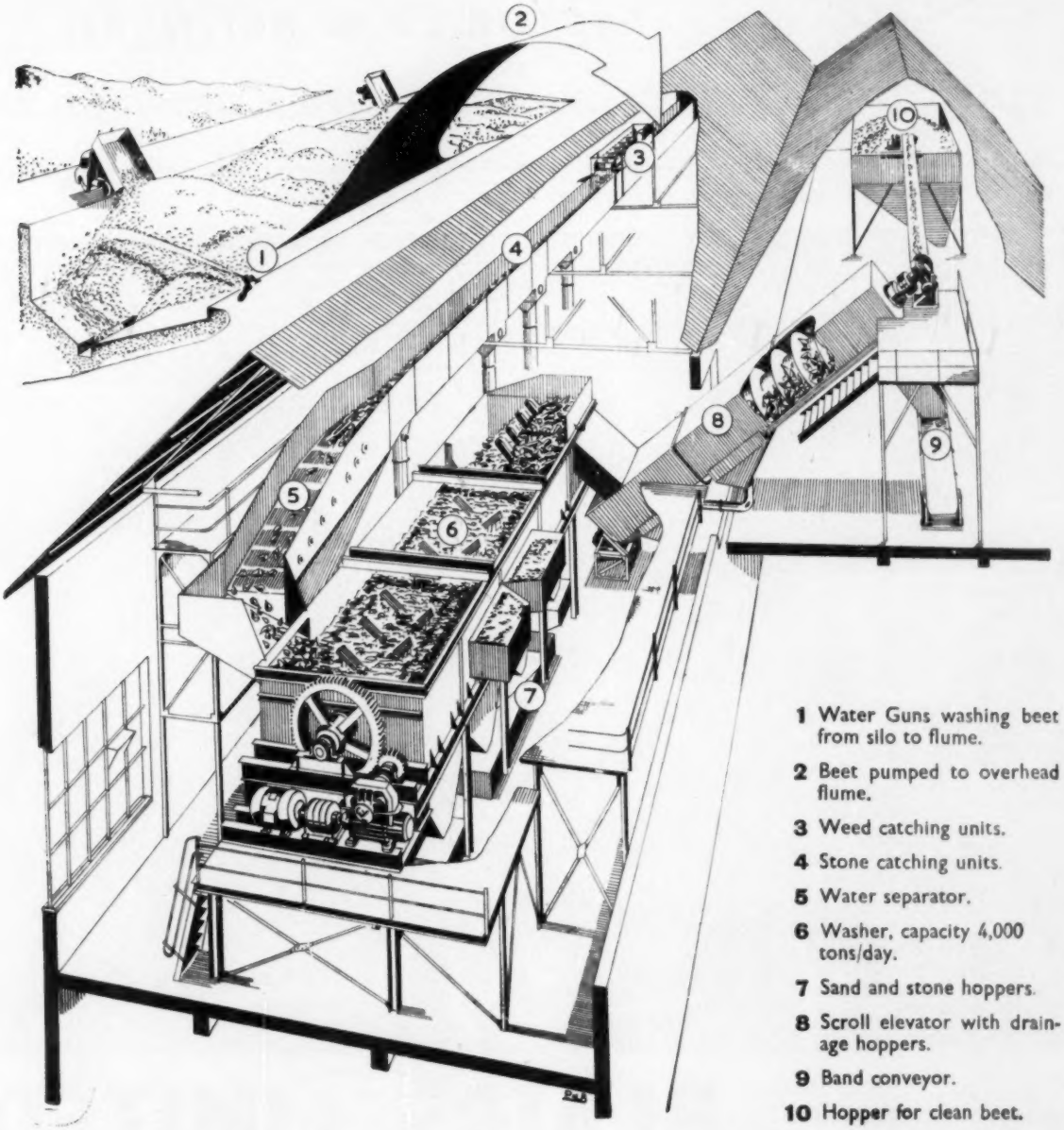

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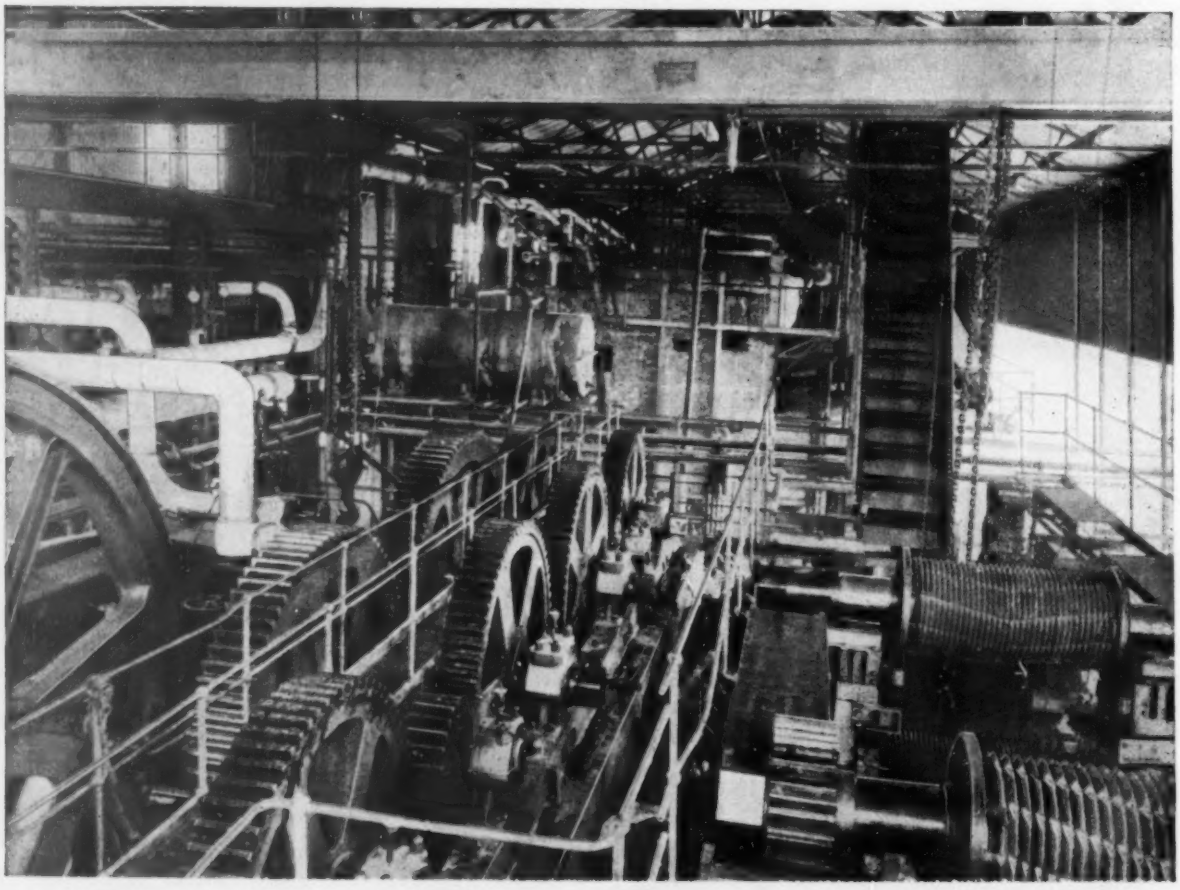

A photograph showing part of a Mill House of a Factory in Jamaica. It will be noted it was taken during off-season inspection.

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flask, acidifying and making up to 110 ml, distilling off 75 ml, adding 25 ml water until 100 ml is distilled and repeating until finally 145 ml have been distilled. Otherwise three 80-ml parts may be distilled off and 2 80-ml volumes of water added. The distillate is titrated against standard alkali and the acid content of the juice calculated.

* * *

Determination of the extinction of sugar products by the "Visomat" colorimeter. J. DOBRZYCKI. *Chemia Analityczna*, 1959, **4**, (1/2), 251–258; through *S.I.A.*, Abs. 926.—The use of a photoelectric colorimeter ("Visomat KWT" or the Polish KF2) has been tested as an alternative to spectrophotometric apparatus. The colorimeter readings are affected by the refractive index of the solution and a formula for correction for this factor has been worked out, so that extinction values can be calculated from "Visomat" colorimeter and refractometer readings. The colorimeter measurements are made with a 100 mm tube and with monochromatic filters for 560 and 460 mμ.

* * *

Sugar beet quality control methods at Sopronharpács. I. HOLLY. *Cukoripar*, 1959, **12**, 235–243: through *S.I.A.*, 1959, **21**, Abs. 928.—An illustrated description is given of beet analysis and control laboratory work.

* * *

Segmental-type rasp with automatic feeder. A. DRABIKOWSKA. *Gaz. Cukr.*, 1960, **62**, 12–14.—A detailed description is given of the beet rasp with illustrations.

* * *

Reconstruction of the beet tare house. G. KLING. *Zuckererzeugung*, 1960, **4**, 15–17.—The tare house at Haldensleben sugar factory was reconstructed in 1958 and new equipment installed, whereby the number of workers has been cut from 10 to 5.

* * *

The influence of colloids on sugar manufacture. L. STEFANOV. *Legkaya Prom.*, 1956, (7), 27–29; through *S.I.A.*, 1960, **22**, Abs. 30.—Experiments have been carried out on the influence of temperature and pH of diffusion on the colloid content of beet juice. The colloidal material from the diffusion of 100 kg of beet was separated by centrifuging the juice. The 6 kg of material obtained consisted of 1·25 kg of cellulose, 1·25 kg of hemicellulose, 2·50 kg of pectin, 0·25 kg of saponin, and 0·15 kg of unidentified sludge material. The temperature, pH and time of diffusion were varied in laboratory tests in order to determine the conditions for the minimum contamination of diffusion juice by pectin (the greatest contaminant). Graphs are given of the results obtained: pectin concentration is proportional to temperature and time, and is at a minimum at about pH 5·5. It is suggested that diffusion should be carried out at $\geq$80°C and for not longer than 60 minutes.

Organic acids in beets and juices. 3. The use of the Craig distribution (method) for determination of the volatile acids. H. D. WALLENSTEIN and H. EGLER. *Zeitsch. Zuckerind.*, 1960, **85**, 66–73.—A description is given of the Craig distribution method of separating quantitatively the volatile acids present in minute quantities (down to 0·5 meq/litre of juice) after treatment by ion exchange and distillation. The substances are distributed between two miscible and mutually saturated solvents, the upper liquid layer being gently agitated. The heavier solvent remains as a stationary phase, while the lighter layer is the mobile phase. The constituents of the mixture either follow the mobile phase or remain with the stationary phase, according to their solubility. Thus several substances can be separated from one another and their contents determined by the normal methods. The non-miscible substances are agitated in a separate portion and separated. Theoretical calculation of the distribution is discussed and an automatic apparatus for 100 distribution stages in test tubes is described with illustrations. *n*-Butanol and water (1:1), purified and filtered before use, were used as solvents. After distribution, the fractions are emptied from the test tubes into 150-ml beakers, the residual solvents being dissolved by addition of methanol, to give a homogeneous solution which can be titrated potentiometrically against N/100 NaOH to pH 8·4. Titration is carried out under the same conditions against a formic, acetic and butyric acid solution of known content, consisting of the particular acid, 25ml water, 25 ml *n*-butanol and 15–20 ml methanol. Methanol and water are also added to the upper phase fractions. The titration values were used to establish reference curves and the data are tabulated. The accuracy of the distribution itself is $\pm$3%, and of the titration $\pm$3–4% with greater amounts and $\pm$5–8% with smaller amounts (about 10 ml).

* * *

Determination of moisture in sugars by drying methods. T. NAGAHARA and C. TSUTSUMI. *Shokuryo Kenkyüsho Kenkyu Hokoku* (*Rpt. Food Res. Inst., Tokyo*), 1958, **13**, 83–84; through *J. Sci. Food Agric. Abs.*, 1959, **11**, i–84.—Moisture was determined in six grades of sugar (14 samples) by heating (i) under reduced pressure (25–30 mm Hg) to constant weight, (ii) 3 hr at 105°, or (iii) 15, 30, 45 or 60 min at 130°. In general method (ii) gave higher results than method (i). Longer heating by method (iii) gave higher values and the sugars became brown because of decomposition. Method (iii) for 15 min gave slightly higher values than method (i) and was satisfactory for routine work.

* * *

The importance of physical chemistry in the development of the sugar industry. V. VALTER. *Listy Cukr.*, 1960, **76**, 42–46.—Application of physical chemistry methods to research, analytical methods, and to sugar technology (and resulting changes), including crystallization, is discussed. The possible significance for the sugar industry of developments in nuclear physics is mentioned.

Determination of dextran and starch in cane juices and sugar products. R. I. NICHOLSON and M. HORSLEY. *J. Agric. Food Chem.*, 1959, **7**, 640–643; through *J. Sci. Food Agric. Abs.*, 1959, **11**, i–83.—The method described for the rapid assay of dextran and starch in presence of sucrose is based on co-precipitation of starch and dextran by alcohol in presence of salts, dissolving the precipitate by digestion with formamide, and determining starch colorimetrically with iodine on one aliquot, and dextran on another aliquot by measurement of haze after removal of starch by salivary amylase. Both impurities are of importance in sugar refineries, starch being associated with problems of filtration, and dextran in sugar solution indicating delay in harvesting or spoilage of juice. Standard curves are constructed with sugar cane starch or potato starch, and with dextran from *Leuconostoc mesenteroides*.

* * *

Molasses crystallization curves for the 1957 and 1958 campaigns. M. MRKVIČKOVÁ. *Listy Cukr. Supp.*, 1960, 1–2.—Tests were conducted on molasses crystallization of low-product massecuite after dilution to lower viscosity. Graphs are presented and the effect of the crystal size on the establishment of standard molasses (Silin) is emphasized. The method proposed by ŠEPITKA[1] for determining standard molasses purity is criticized, as it is considered too complicated. The Czechoslovak standard molasses should have a Brix of 71° and a purity of 69.

* * *

The effects of ultra-violet radiation on the quality of inverted sugar syrup. M. KOMOTO and S. FUJII. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1959, **8**, 74–82.—Ultra-violet radiation was found to reduce the colour and pH of invert syrups, and an adsorption peak at 283 mμ shifted to 267 mμ, returning on storage of the irradiated syrup. The optical densities of the irradiated syrups were always higher than the controls, however, and when both were stored at pH below 3 colour formation was quicker in the irradiated syrups, the colour intensity increasing with time of irradiation. An ether extract of the irradiated syrup accelerated colour formation. Such constituents of the invert syrups as sucrose, fructose, glucose, 5-hydroxymethyl furfural, levulinic acid and formic acid were not coloured by irradiadion when treated separately, but the presence of levulinic acid in the stored irradiated fructose and glucose solutions accelerated colour formation. Evolution of CO_2 gas was proportional to the irradiation time and was attributed to formation of 1 mol of CO_2 and 2 mols of monobasic acid or 1 mol of CO_2 and 1 mol of dibasic acid from 1 mol of fructose.

* * *

Determination of iron in the sugar refining process. Y. MATSUDA. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1959, **8**, 83–87.—Refinery products were analysed for iron by TÖDT's method[2] using addition of known quantities to determine the accuracy. Mean errors for fine liquor, clear liquor and raw sugar solutions was 4–5% and for affination greens was 8·04%. Maximum errors were about 10%. Iron contents of the various products are presented in a series of tables.

* * *

Chemical composition of sugar beet growing in the warm regions of Japan. M. KOMOTO, T. MAEDA, and E. HAMAGUCHI. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1959, **8**, 92–100.—Beets from the warmer areas of Japan were found to be of smaller root weight, lower purity (81·2 average) and higher total N content than those from colder climates but could give thin juice purities higher than 90.

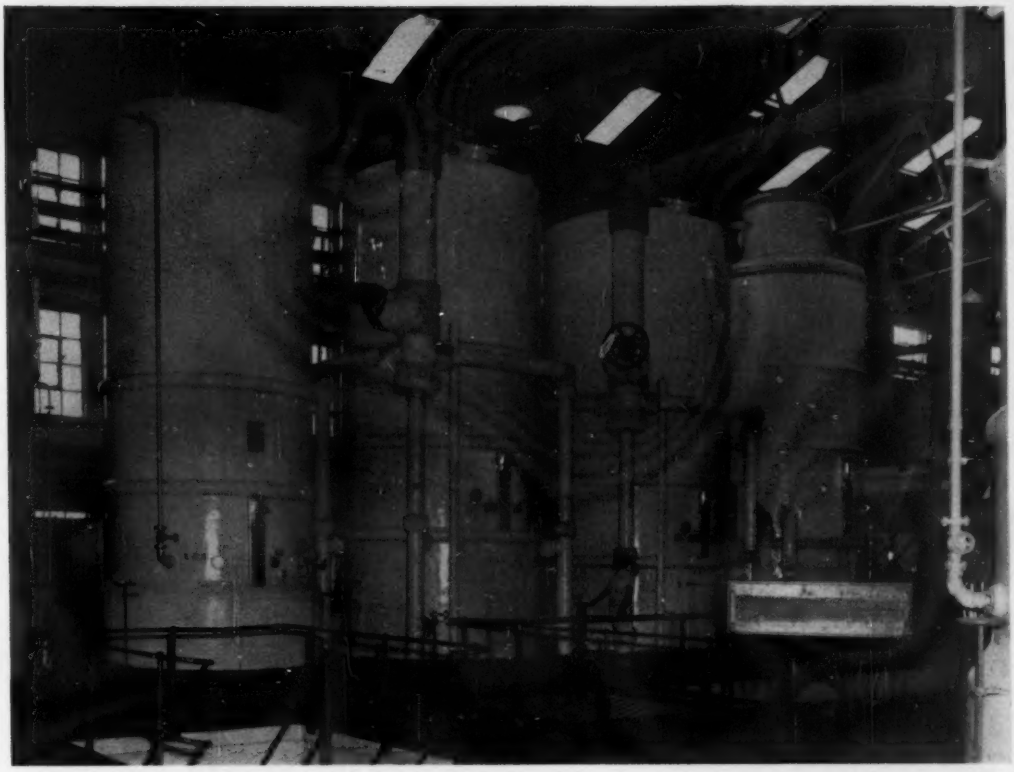
* * *

Fractionation of sugars in beet molasses—Fractional determination of raffinose. N. NUNOKO. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1959, **8**, 112–115.—A chromatography column was prepared by pouring a slurry of 25 g kieselguhr and 25 g active carbon into a glass cylinder of 3·5 cm dia. and 25 cm long. To the column was added 100 cc of a 5% alcohol solution containing 5 g sucrose and 0·4 g raffinose; the sugars were adsorbed and then eluted with 8 × 100 cc of 5% alcohol. This removed 98·5% of the original sucrose while not removing the raffinose. On further elution with 200 cc of 15% alcohol solution a further 0·3% of the sucrose was recovered while a further 300 cc removed 98·75% of the raffinose. Similar elution of a column to which had been added 10 g of molasses dissolved in 100 cc of 15% alcohol separated the sucrose content (52·7%) and raffinose (5·4%), the latter crystallizing from the collected and concentrated eluates.

* * *

The colouring matter in refinery liquors. T. YAMANE and F. ONDA. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1959, **8**, 116–121.—Colouring matter was separated from the regeneration effluent of decolorizing resins by dialysing and ion exchange treatment and vacuum concentration and drying. It had an empirical formula $C_{17-18}H_{26-28}O_{13-14}N$. After oxidation with sodium periodate and hydrogenation[3] certain amino acids and polyols were identified by paper chromatography. It is considered that the colouring matter may be formed by condensation of one mol each of sugar humic acid and amino acid and thus is the same as that separated from cane final molasses.

[1] *I.S.J.*, 1959, **61**, 309.
[2] *Zucker*, 1954, **7**, 222; *Zeitsch. Zuckerind.*, 1954, **4**, 336.
[3] Cf. BINKLEY: *I.S.J.*, 1958, **62**, 64, 165, 322.



Evaporators at the British Sugar Corporation Beet Sugar Factory at Cupar fitted with H & W 70/30 Brass Tubes. The evaporators are lagged with plastic lagging. (Photograph by courtesy of the British Sugar Corporation Limited).

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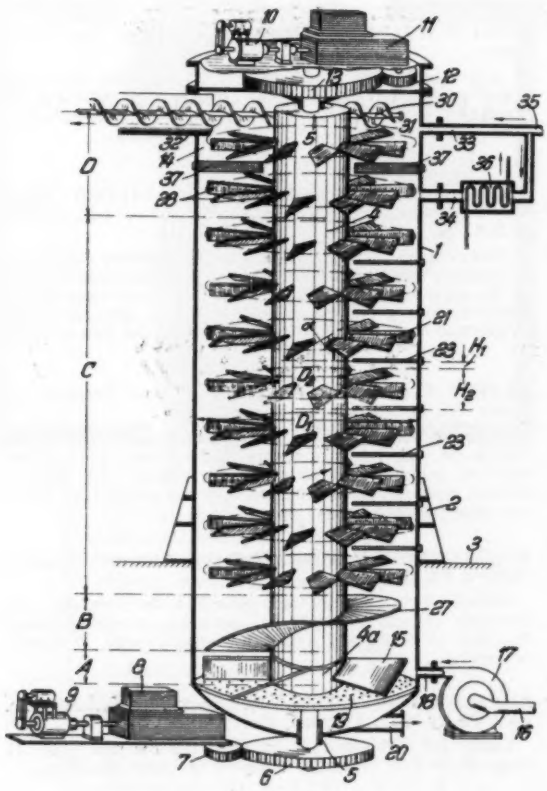
Beet diffuser. W. KAETHER, assr. BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT, of Braunschweig, Germany. **2,927,007.** 16th April 1958 ; 1st March 1960.—In the diffusion tower illustrated there are four zones: the stirring zone A above the juice withdrawal screen 19, the separating zone B where the scroll 27 raises the cossettes to the treatment zone C, and



the ejection zone D. In the four zones are conveyor mechanisms attached to the central shaft which may be in two parts, top- and bottom-driven respectively at the required speeds. A feature of the treatment zone C is that the inclined blades 21 are "stepped" with relation to those above and below; this together with other factors including a ratio of tower dia.: shaft dia. of 2—2·5:1, a ratio of free space height to blade wheel height of no more than 1:1, blade angle of 10–25°, approximately 60% liquid in the cossette-juice mixture, and shaft speed of 20–40% of shaft speed for a tower with blocking members, permits the operation of the tower without such blocking members to guide the cossettes upwards and prevent horizontal rotation with the shaft. In fact, such blocking members or guide plates 23 are provided, but are rotatably mounted so that in normal operation they do not interfere with the flow of material; should the supply of water be interrupted or similar disturbance occur, the guide plates can be turned and the shaft speed be increased to keep the cossettes in suspension and prevent their settling to a compact mass in the bottom of the tower. Guide plates 37 in the ejection zone D provide mechanical means of transporting the exhausted cossettes to the discharge scroll 30.

* * *

Beet diffuser. W. KAETHER and F. MUSHACK, assrs. BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT, of Braunschweig, Germany. **2,924,541.** 18th January 1956; 9th February 1960.—See U.K.P. 786,606.[1]

* * *

(Isolation and) Purification of glutamine (from beet juice). E. V. MCCOLLUM and A. A. RIDER, of Baltimore, Md., U.S.A. **2,928,869.** 30th July 1957; 15th March 1960.—A dry mixture of glutamine and other amino acids is derived from beet juice, e.g. by decolorizing with carbon, filtering, evaporating at <50°C and adding sufficient anhydrous sodium sulphate to bind most of the remaining water when the concentrate becomes a semi-solid mass. It is treated with a solution in a lower alkyl ketone (acetone) of an organic acid—either trichloroacetic acid or an aromatic sulphonic acid forming a ketone-(acetone-) soluble compound with glutamine. The liquid phase is separated from the undissolved material and neutralized by adding ammonia (e.g. as an anhydrous solution in acetone). This precipitates glutamine, other amino-acids and ammonium salts which are separated from the solvent. The precipitate is treated with a solution of calcium chloride in methanol which dissolves the ammonium salts and the amino-acids other than glutamine. The undissolved glutamine residue may be recrystallized from aqueous ethanol.

[1] *I.S.J.*, 1958, **60**, 177.

Copies of Specifications of United Kingdom Patents can be obtained on application to H.M. Patent Office, 25 Southampton Buildings, London, W.C.2. (price 3s. 6d. each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. (price 25 cents each).

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Lubrication Fault indicator. Exactor Ltd., Exactor Works, Church Way, Edgware, Middlesex.

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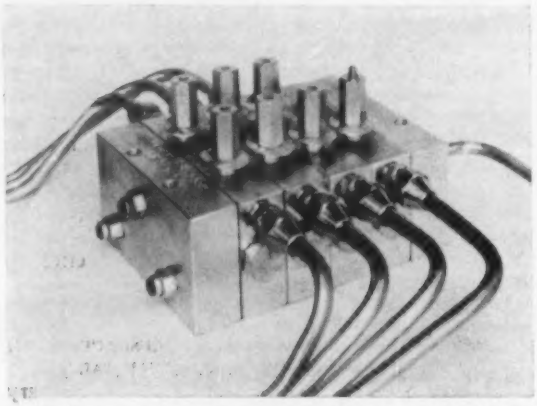

system operates and the indicator pin, which may be supplied in bright colours, rises $^{5}/_{32}$-in out of the body, so pinpointing the faulty line. The pin returns to normal position automatically once the fault has been corrected. In the illustration the extreme right indicator pin is risen to locate a faulty lubrication line.

* * *

Hilger J 40 Colourmeter. Hilger & Watts Ltd., 98 St. Pancras Way, Camden Rd., London N.W.1.

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PUBLICATIONS RECEIVED.

MIRRLEES REVOLVING CANE KNIVES. The Mirrlees Watson Co. Ltd., Scotland Street, Glasgow, Scotland.

A new leaflet, S 127, illustrates and describes the Mirrlees revolving cane knives which may be of normal pitch with 2-arm hubs or close pitch with 4-arm hubs. Details are given of the blades, flexible coupling, heavy flywheel, hood, cane carrier slats, chute angle and prime movers. Typical methods of driving the knives and adjusting the cutting clearances are illustrated and photographs given of several of the installations which are also listed in a large table. A questionnaire designed to provide the information necessary when quoting concludes the leaflet.

* * *

KENT INSTRUMENT PANELS. George Kent Ltd., Luton, Beds.

A four-page leaflet, Publication 150 of October 1959, illustrates and describes some of the wide range of plate and unit panels now available as standard assemblies for instrumentation schemes, including those in the sugar industry.

* * *

HONIRON EVAPORATOR CONTROL SYSTEMS. Honolulu Iron Works Company, 165 Broadway, New York 6, N.Y., U.S.A.

This new general bulletin describes the Honolulu Iron Works Company's "application engineering" of automatic controls in the sugar industry. Other bulletins deal with more specific topics including evaporator rate and level controllers, pre-evaporator controls and automatic vacuum and Brix controls.

* * *

RUBBER CONVEYOR BELTING. Turner Brothers Asbestos Co. Ltd., Rochdale, Lancashire.

A new catalogue, BA 73, deals with conveyor belting, detailing the wide range of natural and synthetic fibre, rubber covered, conveyor belts which are available. In addition, there is much information on conveyor belt installation, operation and maintenance.

* * *

FLUID FLOW RATE ALARMS. Brooks Rotameter Company, Hatfield, Pa., U.S.A.

Bulletin 175 illustrates and describes the magnetic and electronic alarms developed for signalling or simple control functions in connexion with the standard range of Brooks rotameters.

* * *

AIR FLOW INDICATORS. Rotameter Manufacturing Co. Ltd., Purley Way, Croydon, Surrey.

Leaflet RP.2021 describes and illustrates the new Type 715 range of air flow indicators designed for panel mounting.

* * *

Honolulu Iron Works Developments.—The New York Engineering Branch of the Honolulu Iron Works Company, which acts on a world-wide basis as consultants and contractors to the sugar industry, has recently completed extensions and improvements of over $4,000,000 to sugar factories in Latin America and the Philippines. They are also presently engaged in a development programme which includes studies of the application of automatic controls to sugar factory equipment, as well as the testing of new designs. The appointment is also announced of a new sugar technologist member of their regular staff, Mr. L. E. Aucoin, to represent the Company in Louisiana and Mexico.

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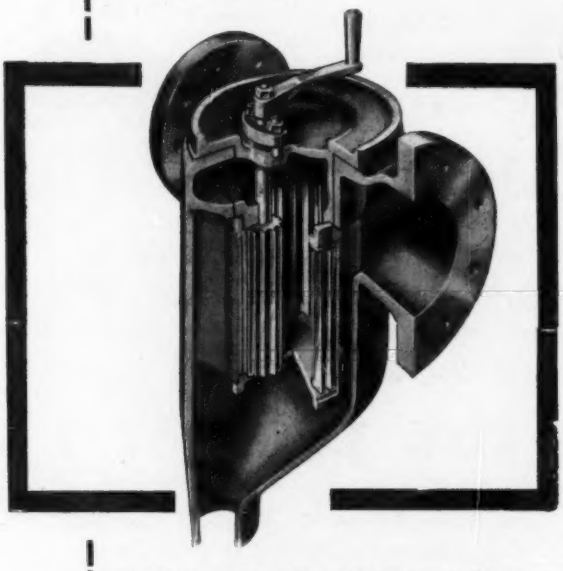

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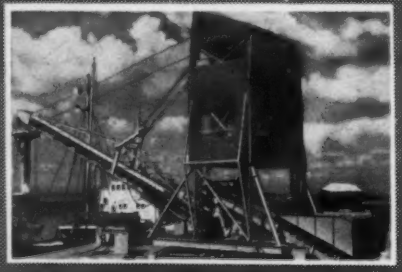
A Crone & Taylor Bulk Cargo Loader & Thrower
Photograph by courtesy of Messrs. I.C.I. Ltd. Salt Division, Runcorn

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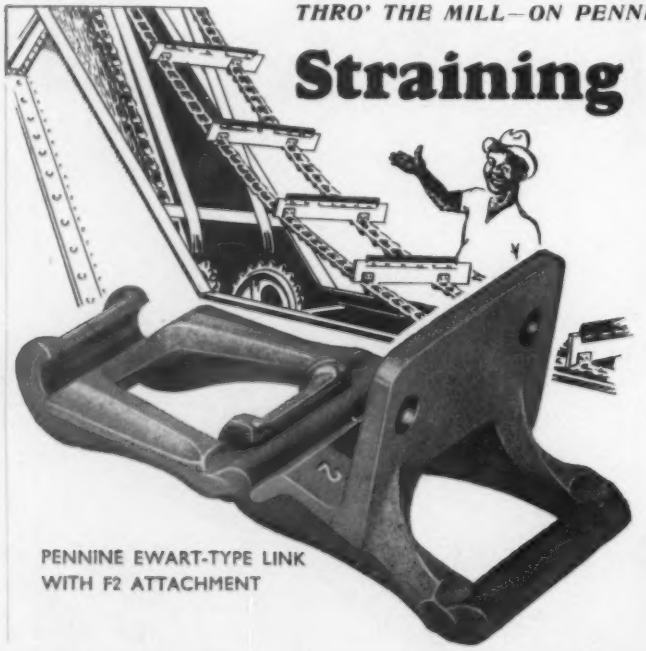
THRO' THE MILL—ON PENNINE CHAIN

Straining the juice . . .


PENNINE EWART-TYPE LINK
WITH F2 ATTACHMENT

Parallel strands of Pennine Ewart-type detachable chains with F2 attachments spaced at intervals are suitable for Juice Strainer and Trash Elevator operation. Rubber-edged steel flights between strands are secured to the F2 links, which are strongly made to give maximum wear.

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ICUMSA

The following Referees have been appointed to serve at the 13th Session to be held in Berlin in September 1962.

Subject	
1.	Constitution and By-laws. H. C. S. de Whalley (U.K.)
2.	Weighing, taring and sampling of sugars. A. E. Tate (U.K.)
3.	Ash. K. Douwes Dekker (South Africa)
4.	Reducing sugars. E. J. McDonald (U.S.A.)
5.	Bone charcoal and other adsorbents. V. R. Deitz (U.S.A.)
6.	Sucrose in molasses (by chemical methods). W. W. Binkley (U.S.A.)
7.	Refractive index. –. Rosenhauer (Germany)
8.	Quartz control plates. R. Bünnagel (Germany)
9.	Refining qualities of beet sugars. P. Devillers (France)
10.	Refining qualities of cane sugars. C. W. Davis (Australia)
11.	Specifications and tolerances for pure sucrose and reagents. J. Henry (Belgium)
12.	Crystallizing qualities of sugar solutions. A. VanHook (U.S.A.)
13.	Colour, turbidity and reflectance. P. F. Meads (U.S.A.)
14.	Sucrose in all sugar products (by polarimeter). J. Dubourg (France)
15.	Dry substance in sugar products. L. Cavallaro (Italy)
16.	pH. D. Gross (U.K.)
17.	Refined sugar constituents other than sucrose, invert, ash, water and colour. G. P. Meade (U.S.A.)
18.	Laboratory apparatus (informative only).
19.	Viscosity and surface tension. H. I. Waterman (Holland)
20.	100°S point, sugar scale and automatic polarimetry. F. Schneider (Germany)
21.	Polarization of raw sugars. R. W. Rutledge (Australia)
22.	Raffinose, other oligosaccharides and glycosides. A. Carruthers (U.K.)
23.	Sucrose in sugar beet. H. Hirschmüller (Germany)
24.	Sugar deterioration. H. E. C. Powers (U.K.)
25.	Inorganic non-sugars. R. Saunier (France)
26.	Starch hydrolysis products (all constituents and properties). W. Kempf (Germany)
27.	Organic non-sugars. P. Honig (U.S.A.)
28.	Sugars in sugar cane. L. F. Martin (U.S.A.)
29.	Microbiological tests. R. Weidenhagen (Germany)

BREVITIES

The late W. W. Sprague.—The death occurred on May 17th 1960 of W. W. Sprague, Executive Vice-President of the Savannah Sugar Refining Corporation. Mr. Sprague was born in 1895 and was a fifth-generation sugar man although his first interests were in mining engineering and he did not enter the sugar industry until 1919. He worked in Hawaii and Louisiana and later at the Port Wentworth, Georgia refinery, rising from sugar boiler to general superintendent and becoming a director in 1929 and Executive Vice President in 1946. Perhaps his most notable achievement was that the Savannah

Corporation is one of the small number of companies which sets an example of industrial peace and harmony where there is a unanimity of interest between operating, maintenance and management personnel. Following his death L. C. Calhoun becomes Executive Vice President, F. M. Exley becomes Vice President (Operations) and W. W. Sprague, Jnr., a director of the Company.

* * *

International Sugar Council.—A total quantity of 107,307 metric tons, surrendered under the terms of Article 11(1) of the International Sugar Agreement, was redistributed on 25th May 1960. Details of the surrenders, redistribution and quotas in effect following the redistribution are given below:—

Country	*Quotas in effect on 1st April 1960*	*Surrenders subject to redistribution*	*Redistribution of 107,307 tons*	*Quotas following redistribution in previous column*
Belgium	0			0
Brazil	518,009		13,368	531,377
China	717,142		15,920	787,062
Cuba	2,592,510		58,696	2,651,206
Czechoslovakia	258,773	68,941		189,832
Denmark	30,000	954		29,046
Dominican Republic	669,092		15,920	685,012
France	0			0
Haiti	6,000			6,000
Hungary	36,574		972	37,546
Indonesia	50,000			50,000
Italy	20,859	20,859		0
Mexico	70,114		1,823	71,937
Netherlands	0			0
Peru	486,553	16,553		470,000
Philippines	44,074		608	44,682
Poland	50,000			50,000
Portugal	0			0
U.S.S.R.	0			0
Total	5,603,700	107,307	107,307	5,603,700

The following countries, affected by the Council's determination under Article 19(2) on 31st March 1960, formally renounced their right to fill their export quota which was in effect on that date: Denmark, the Kingdom of the Netherlands, Poland, Portugal and the U.S.S.R. Under the proviso to that Article, Belgium retained the right to export 18,800 tons, Haiti 20,000 tons, and Indonesia 100,000 tons. Figures for Haiti and Indonesia include their present quotas in effect.

BREVITIES

Spanish sugar production, 1959/60[1].—*El Economista* of Madrid reports provisional figures of outturn of the 1959/60 crop at 498,875 tons, of which 470,375 are from beet and 28,500 from cane. Production in 1958/59 was 428,716 tons while in 1957/58 it was only 325,000 tons.

* * *

Erratum.—A correspondent from Ceylon has pointed out to us that in the news item that we reprinted in our April issue[2], the first part of a Dept. of Industries circular has been misinterpreted and that the factories mentioned are those already existing instead of planned new factories. The Consulting Engineering Group are required to advise and ascertain the economic feasibility of possible by-products of the sugar industry, as described towards the end of our Brevity.

* * *

Indian sugar production increase plans.[3]—The Indian Minister of Food, Mr. S. K. PATIL, recently announced that India would import no sugar even in the case of a shortage, since sugar was not necessary for life. In spite of this, the Government would, however, make all efforts to increase the reserves. Indian sugar production is to be raised by 400,000 tons on that of last year. The latest estimates of Indian sugar production for 1959/60 amount to 2,425,000 tons as against 2,162,000 tons last season. During the period of the third Five-Year Plan (1961–66) consumption is expected to rise to 3 million tons a year. During the 1960/61 season 11 new factories will be put into operation in India.

Stock Exchange Quotations

London Stocks (*at 17th June*, 1960)	CLOSING MIDDLE
Anglo-Ceylon (5s)	17/10½
Antigua Sugar Factory (£1)	15/–
Booker Bros. (10s)	35/9
British Sugar Corp. Ltd. (£1)	22/6
Caroni Ord. (2s)	4/4½
Caroni 6% Cum. Pref. (£1)	17/–
Distillers Co. Ltd. (10s units)	37/–
Gledhow Chaka's Kraal (£1)	47/6
Hulett & Sons (£1)	50/–
Jamaica Sugar Estates Ltd. (5s units)	5/1½
Leach's Argentine (10s units)	19/–
Reynolds Bros. (£1)	38/9
St. Kitts (London) Ltd. (£1)	18/–
Ste. Madeleine (Ord.) (£1)	33/3
Sena Sugar Estates Ltd. (10s)	19/9
Tate & Lyle Ltd. (£1)	57/9
Tate & Lyle Investments Ltd. (5s)	10/10½
Trinidad Sugar (5s stock units)	27/–
United Molasses (10s stock units)	41/–
West Indies Sugar Co. Ltd. (£1)	19/–

New York Stocks (*at 16th Jnne*, 1960)	CLOSING MIDDLE $
American Crystal ($10)	39
Amer. Sugar Ref. Co. ($100)	25⅝
Central Aguirre ($5)	22¼
Cuban American ($10)	14¾
Great Western Sugar Co.	26⅞
South P.R. Sugar Co.	15⅝
United Fruit Co.	23¾

Thailand ban on sugar imports[4].—According to a Reuter report, the Thailand Government has banned all sugar imports into that country. Its Cabinet has ordered the Minister for Industry to give financial assistance to local manufacturers in order to improve the quality and lower the cost of domestically produced sugar. Thirteen mills are reported to have benefited under this policy.

* * *

The late Sir Alfred Wood.—Sir ALFRED WOOD, a pioneer of the British sugar beet industry died on the 23rd May at the age of 81. After the 1914–18 war, in association with leading agriculturists, he initiated and organized the original British Sugar Beet Society formed to cultivate public opinion in favour of the nascent industry. The success of the venture is now history; in due course, 18 factories were built by 15 companies, with over 40,000 growers supplying beet to the factories. WOOD was secretary to five of the sugar companies and when all factory interests were united in the British Sugar Corporation Ltd., his offices and staff were taken over as the Corporation's headquarters. The new organization he served first as secretary and later as a director.

International Commission of Sugar Technology (C.I.T.S.)

THE next meeting of the commission will be held at Frankfurt, Germany, on 13th and 14th September 1960. "The technical value of the sugar beet" has been chosen as the subject for the discussions.

The meetings will take place in the lecture-room of the "Pharmazeutisches Institut der Universität Frankfurt," while participants will be welcomed at the Dechema-Haus in Frankfurt on Monday 12th September at 6 p.m.

All intending to participate in the meeting should inform the Secretary of the C.I.T.S. (1, rue Aendoren, Tirlemont, Belgium) as soon as possible and at latest by August 15th.

The 1960 meeting is being organized by Professor Dr. F. SCHNEIDER, Director of the Institut für landwirtschaftliche Technologie und Zuckerindustrie der Technischen Hochschule, in Braunschweig, Germany. Any member of the C.I.T.S. who wishes to present a paper related to the proposed subject must inform Dr. SCHNEIDER at the Institut (Braunschweig, Langerkamp 5, Germany) before June 30th. A time-limit of 20 minutes has been fixed for presenting each paper. In this way a reasonable amount of time may be devoted to its discussion.

In order to facilitate those discussions, the copies of the papers should be distributed before the meeting. In any case, however, 150 reprints, either of the paper or of a broad summary, should be sent to Professor Dr. SCHNEIDER before July 31st. If these instructions are not followed, it might not be possible for the paper to be presented. The summaries may be written in English, German or French.

[1] *Willett & Gray*, 1960, **84**, 162.
[2] *I.S.J.*, 1960, **62**, 116.
[3] F. O. LICHT, *International Sugar Report*, 1960, **92**, (4), 39.
[4] *Willett & Gray*, 1960, **84**, 141.

Four — 40" x 30" x 6" 1500 RPM ROBERTS Fluid Drive Centrifugals for White Sugar with washing, syrup separation, braking, reverse discharging all automatically controlled. Stellite faced loading gates are air operated.

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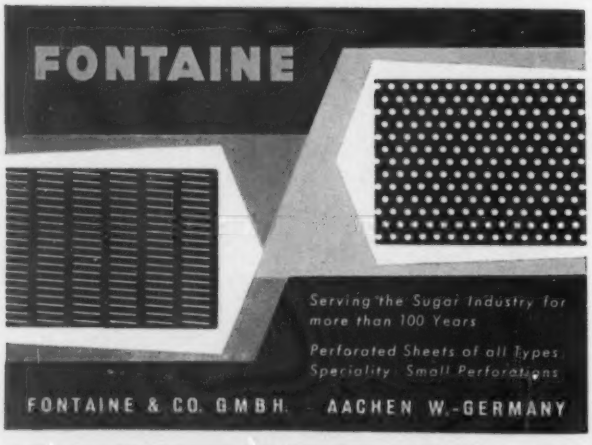
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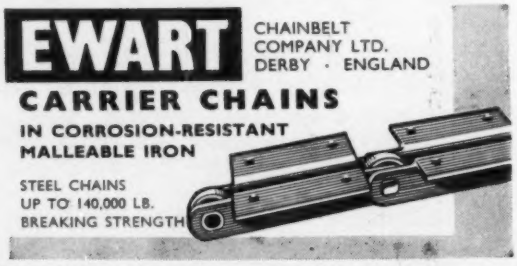

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Degenhardt & Co. Ltd.
Hilger & Watts Ltd.
The Sugar Manufacturers' Supply Co. Ltd
Carl Zeiss Jena.

Conveyor Chains.
Ewart Chainbelt Co. Ltd.
Renold Chains Ltd.

Conveyors and Elevators.
Babcock & Wilcox Ltd.
William Boulton Ltd.
Buhler Brothers.
Hugh Campbell (London) Ltd.
Cocksedge & Co. Ltd.
George Cohen, Sons & Co. Ltd.
Ewart Chainbelt Co. Ltd.
George Fletcher & Co. Ltd.
William Gardner & Sons (Gloucester) Ltd.
Hein, Lehmann & Co. A.G.
Honolulu Iron Works Co.
International Combustion (Export) Ltd.
John King & Co. (Leeds) Ltd.
Kingston Industrial Works Ltd.
Link-Belt Company.
The Mirrlees Watson Co. Ltd.
Pott, Cassels & Williamson Ltd.
Redler Conveyors Ltd.
Salzgitter Maschinen A.G.
Simon Handling Engineers Ltd.
A. & W. Smith & Co. Ltd.
Spencer (Melksham) Ltd.
The Squier Corporation.
Stork-Werkspoor N.V. (V.M.F.)
Strachan & Henshaw Ltd.
John Thompson Conveyor Co.
Whitlock Brothers Ltd.

Apron Conveyors.
Chain Belt Company.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.

Belt and Bucket elevators.
Chain Belt Company.
Crone & Taylor (Engineering) Ltd.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.

Belt Conveyors.
Buhler Brothers.
Chain Belt Company.
Crone & Taylor (Engineering) Ltd.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.
Stephens-Adamson Mfg. Co.

Bucket elevators.
Buhler Brothers.
Chain Belt Company.
Choquenet L. Fonderies et Ateliers.
Crone & Taylor (Engineering) Ltd.
New Conveyor Co. Ltd.
Sandvik Steel Band Conveyors Ltd.

Chain and bucket elevators.
Chain Belt Company.
Crone & Taylor (Engineering) Ltd.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.

Chain conveyors.
Buhler Brothers.
Chain Belt Company.
New Conveyor Co. Ltd.

Drag-bar conveyors.
Chain Belt Company.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.

Feeder conveyors.
Buhler Brothers.
Chain Belt Company.
Crone & Taylor (Engineering) Ltd.
see also Sugar Throwers and Trimmers.

Flight conveyors.
Chain Belt Company.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.

Grasshopper Conveyors.
Thomas Broadbent & Sons Ltd.
Chain Belt Company.
New Conveyor Co. Ltd.

Plate conveyors.
Chain Belt Company.
New Conveyor Co. Ltd.

Pneumatic Conveyors.
Buhler Brothers.

Scraper conveyors.
Buhler Brothers.
Chain Belt Company.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.

Screw conveyors.
Buhler Brothers.
Choquent L. Fonderies et Ateliers.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.

Steel Band Conveyors.
Sandvik Steel Band Conveyors Ltd.

"U"-link conveyors.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.

Conveyors & Elevators (Mobile).
Buhler Brothers.
Crone & Taylor (Engineering) Ltd.

Conveyor Belt Rotary Brushes.
The Kleen-e-ze Brush Co. Ltd.

Coolers, Sugar.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Buell Ltd.
Büttner-Werke A.G.
Buttner Works Inc.
Buttner Works (Canada) Ltd.
George Clark & Sons (Hull) Ltd.
Dunford & Elliott Process Engineering Ltd.
Honolulu Iron Works Co.
Richard Simon & Sons Ltd.
Standard Steel Corporation.
A.B. Svenska Fläktfabriken
Werkspoor N.V.
see also Dryers.

Coolers, Water.
Film Cooling Towers (1925) Ltd.
Heenan & Froude Ltd.
Holden & Brooke Ltd.

Cranes.
Babcock & Wilcox Ltd.
Cary Iron Works.
George Cohen, Sons & Co. Ltd.
Orenstein & Koppel Ltd.
Stork-Werkspoor N.V. (V.M.F.)
The Vaughan Crane Co. Ltd.

Crystallizers.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
P.G. Engineering Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Standard Steel Corporation.
Duncan Stewart & Co. Ltd.
Werkspoor N.V.
John Thompson (Dudley) Ltd.

Cube-making Machinery.
Maschinenfabrik Buckau R. Wolf A.G.
Goka N.V. Machine Works.
The Mirrlees Watson Co. Ltd.
Standard Steel Corporation.

Cube Sugar Moulding, Ranging and Packeting Plant.
Chambon Ltd.
Goka N.V. Machine Works.
Standard Steel Corporation.

Cube Wrapping Machines.
SAPAL.
SIG Swiss Industrial Company

Decolorizing Plants.
Farnell Carbons Ltd.
IMACTI-Amsterdam.
The Permutit Co. Ltd.
Machinefabriek Reineveld N.V.
United Norit Sales Corporation Ltd.

Decolorizing Resins.
Farnell Carbons Ltd.
IMACTI-Amsterdam.
The Permutit Co. Ltd.
Rohm & Haas Company.

Deliming Plants.
Cane Sugar Divn., Dorr-Oliver Inc.
Duper Water Conditioning Cy.
IMACTI-Amsterdam.
The Permutit Co. Ltd.
Machinefabriek Reineveld N.V.

Demineralization Plants.
Cane Sugar Divn., Dorr-Oliver Inc.
Duper Water Conditioning Cy.
IMACTI-Amsterdam.
Paterson Engineering Co. Ltd.
The Permutit Co. Ltd.
Machinefabriek Reineveld N.V.

Diatomaceous Earth, *see* Filter-Aids

Distillery Plant, *see* Alcohol Plant

Drainage and Ridging Machinery.
James A. Cuthbertson Ltd.
Whitlock Brothers Ltd.

Drives, Variable Speed.
David Brown Industries Ltd., Radicon Divn.
Crofts (Engineers) Ltd.
Heenan & Froude Ltd.
Salzgitter Maschinen A.G.

Dryers.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Buell Ltd.
Büttner-Werke A.G.
Buttner Works Inc.
Buttner Works (Canada) Ltd.
George Clark & Sons (Hull) Ltd.
George Cohen, Sons & Co. Ltd.
Dunford & Elliott Process Engineering Ltd.
George Fletcher & Co. Ltd.
William Gardner & Sons (Gloucester) Ltd.
Honolulu Iron Works Co.
Link-Belt Company.
Pott, Cassels & Williamson.
Richard Simon & Sons Ltd.
A. & W. Smith & Co. Ltd.
S.P.E.I. Chim.
Spencer (Melksham) Ltd.
The Squier Corporation.
Standard Steel Corporation.
Duncan Stewart & Co. Ltd.
A.B. Svenska Fläktfabriken.
Werkspoor N.V.

Duckboards.
Grill Floors Ltd.

Dust Control Equipment.
Buell Ltd.
Büttner-Werke A.G.
Dallow Lambert & Co. Ltd.
Dunford & Elliott Process Engineering Ltd.
A.B. Svenska Fläktfabriken.
Carl Zeiss Jena.

Dust Sleeves & Bags.
Heath Filtration Ltd.

Economizers.
George Cohen, Sons & Co. Ltd.
Soc. Fives Lille-Cail.
E. Green & Son Ltd.
John Thompson Water Tube Boilers Ltd.

Electric Heating Tapes and Mantles.
Isopad Ltd.

Electric Motors.
George Cohen, Sons & Co. Ltd.
The Harland Engineering Co. Ltd.
Heemaf N.V.
Hinz Elektromaschinen und Apparatebau.
Lancashire Dynamo & Crypto Ltd.

Electric Power Generators.
George Cohen Sons & Co. Ltd.
Heemaf N.V.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)

Electronic Equipment.
Cambridge Instrument Co. Ltd.
Electroflo Meters Co. Ltd.
Ericsson Telephones Ltd.
Evershed & Vignoles Ltd.
Lancashire Dynamo Electronic Products Ltd.

Engines, Diesel.
Belliss & Morcom Ltd.
George Cohen, Sons & Co. Ltd.
Davy, Paxman & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)

Engines, Steam.
Ashworth & Parker Ltd.
Belliss & Morcom Ltd.
Blairs Ltd.
George Cohen, Sons & Co. Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)

Entrainment Separators.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.

Evaporators and Condensing Plant.
A.P.V. Co. Ltd., Industrial Engineering Dept.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
George Clark & Sons (Hull) Ltd.
George Cohen, Sons & Co. Ltd.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.

Evaporators and Condensing Plant— *continued*
A. & W. Smith & Co. Ltd.
S.P.E.I. Chim.
The Squier Corporation.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.).
Technoexport Czechoslovakia
Wellington Tube Works Ltd.
Worthington-Simpson Ltd.

Filters.
William Boulton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Cotton Bros. (Longton) Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
International Combustion (Export) Ltd.
Krauss-Maffei-Imperial G.m.b.H. & Co.
The Mirrlees Watson Co. Ltd.
H. Putsch & Comp.
Schumacher'sche Fabrik.
Duncan Stewart & Co. Ltd.
Werkspoor N.V.

Bag pressure filters.
A. F. Craig & Co. Ltd.
Choquenet L. Fonderies et Ateliers

Diatomite filters.
Filtres Philippe S.A.
Niagara Filters Europe.
Etablissements A. Olier.
Paterson Engineering Co. Ltd.
Sparkler International Ltd.
Sparkler Manufacturing Company.

Filter presses.
Filtres Philippe S.A.
Choquenet L. Fonderies et Ateliers.
S. H. Johnson & Co. Ltd.
Progress Engineers Ltd.
Salzgitter Maschinen A.G.

Gravity & Pressure filters.
The Permutit Co. Ltd.

Iron removal filters.
Electromagnets Ltd.
The Permutit Co. Ltd.
Rapid Magnetic Ltd.

Leaf filters.
Dorr-Oliver Inc., Cane Sugar Divn.
Ferguson Perforating & Wire Co.
L. A. Mitchell Ltd.
Niagara Filters Europe.
A. & W. Smith & Co. Ltd.
Sparkler International Ltd.
Sparkler Manufacturing Company.
Suchar Sales Corporation.

Plate and Frame filters.
Blairs Ltd.
Choquenet L. Fonderies et Ateliers.
S. H. Johnson & Co. Ltd.

Pressure filters.
Dorr-Oliver Inc., Cane Sugar Divn.
Eimco (Gt. Britain) Ltd.
Filtres Philippe S.A.
Niagara Filters Europe.
The Permutit Co. Ltd.
Progress Engineers Ltd.
Sparkler International Ltd.
Sparkler Manufacturing Company.
Suchar Sales Corporation.

Rotary vacuum filters.
Davey, Paxman & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Eimco (Gt. Britain) Ltd.
Etablissements A. Olier.
Filtres Philippe S.A.

Upflow filters.
IMACTI Amsterdam.

Filter-Aids.
F. W. Berk & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Dicalite Dept., Great Lakes Carbon Corp.
Farnell Carbons Ltd.
T. B. Ford Limited.
Haller & Phillips Ltd.
Johns-Manville International Corp.
Scottish Diatomite Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Chas. H. Windschuegl Ltd.

Filtercloths.
Cotton Bros. (Longton) Ltd.
Heath Filtration Ltd.
G. H. Heath & Son (1952) Ltd.
Samuel Hill Ltd.
S. H. Johnson & Co. Ltd.
Multi-Metal Wire Cloth Co. Inc.
Nordiska Maskinfilt AB.
Tiss-Metal.

Filter-Leaves.
Dorr-Oliver Inc., Cane Sugar Divn. (*Sweetland*).
Ferguson Perforating & Wire Co.
Multi-Metal Wire Cloth Co. Inc.
Niagara Filters Europe.
Progress Engineers Ltd.
A. & W. Smith & Co. Ltd.
Sparkler International Ltd.
Sparkler Manufacturing Company.

Filter Papers.
W. & R. Balston Ltd.
T. B. Ford Limited.
G. H. Heath & Son (1952) Ltd.
S. H. Johnson & Co. Ltd.
Macherey, Nagel & Co., Inh. Dr. Ing. Adolf Radmacher.
Carl Schleicher & Schüll.
Sparkler Manufacturing Company.
The Sugar Manufacturers' Supply Co. Ltd.

Flanges.
Kirk & Co. (Tubes) Ltd. (*Steel, Stainless Steel*)
Talbot Stead Tube Co. Ltd. (*stainless steel*)

Flowmeters.
Electroflo Meters Co. Ltd.
Evershed & Vignoles Ltd.
Fischer & Porter Ltd.
Lea Recorder Co. Ltd.
Rotameter Manufacturing Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Controls Ltd.
John Thompson Instrument Co. Ltd.
Wright Rain Ltd. (*Irrigation*).
Wright Rain Africa (Pvt.) Ltd. (*Irrigation*).

Friction Materials (Industrial).
Johns-Manville International Corp.

Fullers' Earth.
The Fullers' Earth Union Ltd.

Fungicides.
Fisons Pest Control Ltd.

Gearing, *see* **Reduction Gears.**

Gearmotors.
David Brown Industries Ltd., Coventry Gear Divn.
Crofts (Engineers) Ltd.
Hinz Elektromaschinen und Apparatebau.

Grabs, Cane and Beet.
Joseph Westwood & Co. Ltd.

Granulators, *see* Dryers.

Heat Exchangers, Air-cooled.
Wellington Tube Works Ltd.

Heat Exchangers, Plate Type.
A.P.V. Co. Ltd., Industrial Engineering Division.
Babcock & Wilcox Ltd.
British Boiler Accessories Ltd.
George Cohen, Sons, & Co. Ltd.

Heat Exchangers, Tubular.
A.P.V. Co. Ltd., Industrial Engineering Division.
Babcock & Wilcox Ltd.
Blairs Ltd.
British Boiler Accessories Ltd.
George Clark & Sons (Hull Ltd.
George Fletcher & Co. Ltd.
Foster Wheeler Ltd.
Holden & Brooke Ltd.
Kingston Industrial Works Ltd.
Lepage, Urbain & Cie.
Salzgitter Maschinen A.G.
S.P.E.I. Chim
John Thompson Water Tube Boilers Ltd.
Wellington Tube Works Ltd.

Hydraulic Controls for Valves, etc.
Edwards Engineering Corp.
Duncan Stewart & Co. Ltd.

Insecticides.
Fisons Pest Control Ltd.

Instruments, Process Control.
Beckman Instruments Inc.
Bellingham & Stanley Ltd.
Belliss & Morcom Ltd.
The British Rototherm Co. Ltd.
Cambridge Instrument Co. Ltd.
Electroflo Meters Co. Ltd.
Evershed & Vignoles Ltd.
Fischer & Porter Ltd.
Hilger & Watts Ltd.
Rotameter Manufacturing Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Controls Ltd.
John Thompson Instrument Co. Ltd.

Insulation, Thermal (Heat and Cold).
The Cape Asbestos Co. Ltd.
Johns-Manville International Corp.
William Kenyon & Sons Ltd.
Lafarge Aluminous Cement Co. Ltd.

Ion Exchangers.
W. & R. Balston Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Duper Water Conditioning Cy.
Farnell Carbons Ltd.
IMACTI-Amsterdam.
The Permutit Co. Ltd.
Rohm & Haas Company.
John Thompson-Kennicott Ltd.

Irrigation Equipment.
Farrow & Sons Ltd.
Martin-Markham Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.

Jointings, *see* **Packings and Gaskets.**

Juice Heaters.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Choquenet L. Fonderies et Ateliers.
George Clark & Sons (Hull) Ltd.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)

Juice Scales.
Butz & Leitz G.m.b.H.
George Fletcher & Co. Ltd.
N.V. Servo-Balans.
see also Weighing Machines.

Juice Strainers and Screens.
Ashworth & Parker Ltd.
Blairs Ltd.
William Boulton Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
George Clark & Sons (Hull) Ltd.
Cocksedge & Co. Ltd.
Dei-Con Eastern Corporation.
Dorr-Oliver Inc., Cane Sugar Divn.
Ferguson Perforating & Wire Co.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Link-Belt Company.
Mechans Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)
The Sugar Manufacturers' Supply Co. Ltd.

Juice and Syrup Mixers.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Choquenet L. Fonderies et Ateliers.
George Clark & Sons (Hull) Ltd.
Gutehoffnungshütte Sterkrade A.G.
L. A. Mitchell Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd

Knives, Beet.
Köllmann & Gruhn.
H. Putsch & Comp.

Knives, Milling.
Blairs Ltd
BMA Braunschweigische Maschinenbauanstalt.
Broussard Machine Co.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Farrel-Birmingham Co. Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.

Knives, Milling—*continued*
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
The Squier Corporation.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F).

Knives, Milling, Portable Grinders.
Flexotube (Liverpool) Ltd.

Laboratory Apparatus and Equipment.
International Combustion (Export) Ltd.
Karl Kolb.
The Sugar Manufacturers' Supply Co. Ltd.

Electric Heating appliances.
Isopad Ltd.
see also Laboratory Instruments *and* Saccharimeters and Polarimeters, *etc.*

Laboratory Instruments.
Beckman Instruments Inc.
Belliss & Morcom Ltd.
The British Rototherm Co. Ltd.
Cambridge Instrument Co. Ltd.
Degenhardt & Co. Ltd.
Ericsson Telephones Ltd.
Evershed & Vignoles Ltd.
Fischer & Porter Ltd.
Rotameter Manufacturing Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
John Thompson Instrument Co. Ltd.
Carl Zeiss Jena.

Refractometers.
Bellingham & Stanley Ltd.
Hilger & Watts Ltd.
Schmidt & Haensch.

Laboratory Reagents.
Riedel-de Haën A.G.
The Sugar Manufacturers' Supply Co. Ltd.

Ladders, Steel Lattice.
Grill Floors Ltd.

Lime Density Meters.
Rotameter Manufacturing Co. Ltd.

Liming Equipment.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Cocksedge & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
Stork-Werkspoor N.V. (V.M.F.)
The Sugar Manufacturers' Supply Co. Ltd.

Load Cells.
Ericsson Telephones Ltd.

Locomotives, Diesel.
Andrew Barclay, Sons & Co. Ltd.
George Cohen, Sons & Co. Ltd.
The Drewry Car Co. Ltd.
F. C. Hibberd & Co. Ltd.
Robert Hudson Ltd.
Hudswell, Clarke & Co. Ltd.
Hunslet Engine Co. Ltd.

Locomotives, Diesel—*continued*
N.V. Locospoor.
Orenstein & Koppel Ltd.
Railway Mine & Plantation Equipment Ltd.
Spoorijzer N.V. Delft.
U.S. Industries Inc. (Great Britain) Ltd.

Magnetic Separators.
Electromagnets Ltd.
Permag Ltd.
Rapid Magnetic Ltd.

Massecuite Heat Treating Equipment.
Blairs Ltd.
George Fletcher & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Pott, Cassels & Williamson Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)
The Western States Machine Co. (*Stevens System*).

Mechanical Crop Thinning Machines.
S.K.H. & Son (Salopian–Kenneth Hudson & Son).

Metal Detectors.
Metal Detection Ltd.

Mill Hydraulics.
Edwards Engineering Corp.
The Mirrlees Watson Co. Ltd.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)

Mill Rolls.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
G. M. Hay & Co. Ltd.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
The Squier Corporation.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)

Mill Roll Movement Indicators and Recorders.
Edwards Engineering Corp.

Milling Plant.
Blairs Ltd.
BMA Braunschweigische Maschinenbauansta't.
David Brown Industries, Ltd., General Gear Division.
David Brown Industries Ltd., Jackson Division.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Farrel-Birmingham Co. Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
G. M. Hay & Co. Ltd.
Honolulu Iron Works Co.
International Combustion (Export) Ltd.
Kek Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.

Milling Plant—*continued*
The Squier Corporation.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.).
Technoexport Czechoslovakia.
see also Shredders.

Mineral Trace Elements.
Fisons Pest Control Ltd.

Molasses Tanks.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
George Clark & Sons (Hull) Ltd.
Kingston Industrial Works Ltd.
Mechans Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)

Nematocides.
Fisons Pest Control Ltd.

Packeting Machinery.
Brecknell, Dolman & Rogers Ltd.
Chambon Ltd.
Fr. Hesser Maschinenfabrik A.G.
Richard Simon & Sons Ltd.
SIG Swiss Industrial Company.

Packings and Gaskets.
The Cape Asbestos Co. Ltd.
Johns-Manville International Corp.

Pans, Vacuum.
A.P.V. Co. Ltd., Industrial Engineering Dept.
Blairs Ltd.
William Boulton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
George Clark & Sons (Hull) Ltd.
George Cohen, Sons & Co. Ltd.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
Mechans Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
The Squier Corporation.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)
Technoexport Czechoslovakia.
John Thompson (Dudley) Ltd.

Paper and Board from Bagasse.
Cellulose Development Corp. Ltd.
Lyddon & Co. Ltd.

Pipes, Steam.
Kirk & Co. (Tubes) Ltd.
Duncan Stewart & Co. Ltd.
Talbot Stead Tube Co. Ltd.
Wellington Tube Works Ltd.

Pipe Fittings.
see Tube Fittings.

Ploughs—Disc.
David Brown Industries Ltd., Tractor Division.
Martin-Markham Ltd.
Ransomes Sims & Jefferies Ltd.
S.K.H. & Son (Salopian–Kenneth Hudson & Son).

Ploughs—Reversible.
Ransomes, Sims & Jefferies Ltd.
S.K.H. & Son (Salopian—Kenneth Hudson & Son)

Ploughs—Share.
David Brown Industries Ltd., Tractor Division.
Ransomes Sims & Jefferies Ltd.

Power Transmission Equipment.
Chain Belt Company.
Crofts (Engineers) Ltd.
Farrel-Birmingham Co. Inc.
Heenan & Froude Ltd.
William Kenyon & Sons Ltd.
Renold Chains Ltd.

Preliming equipment.
A/S De danske Sukkerfabrikker.

Pressure Gauges.
The British Rototherm Co. Ltd.

Printing Machinery—Rotary Multi Colour for Sugar Cartons and Bags, etc.
Chambon Ltd.
Fr. Hesser Maschinenfabrik A.G.

Pulverizers, Sugar.
George Cohen, Sons & Co. Ltd.
Gruendler Crusher & Pulverizer Co.
Kek Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Pumps.
BMA Braunschweigische Maschinenbauanstalt.
Cellulose Development Corp. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
The Harland Engineering Co. Ltd.
Holden & Brooke Ltd.
International Combustion (Export) Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
The Squier Corporation.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)
The Sugar Manufacturers' Supply Co. Ltd.
Worthington-Simpson Ltd.

Boiler Feed pumps.
The Permutit Co. Ltd.
Saunders Valve Co. Ltd.

Centrifugal pumps.
Saunders Valve Co. Ltd.

Corrosion-proof pumps.
A.P.V. Co. Ltd., Industrial Engineering Dept.
L. A. Mitchell Ltd.
Mono Pumps Ltd.
Saunders Valve Co. Ltd.

Gear pumps.
David Brown Industries Ltd., General Gear Divn.

Irrigation Pumps.
Farrow & Sons Ltd.
Martin-Markham Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.

Molasses Pumps.
Comet Pump & Engineering Co. Ltd.
Mono Pumps Ltd.

Positive-action Pumps.
Comet Pump & Engineering Co. Ltd.
Mono Pumps Ltd.
Progress Engineers Ltd.

Rotary Pumps.
Comet Pump & Engineering Co. Ltd.
Mono Pumps Ltd.
Machinefabriek Reineveld N.V

Self-Priming Pumps.
Chain Belt Company.
Comet Pump & Engineering Co. Ltd.
Mono Pumps Ltd.
Progress Engineers Ltd.
Saunders Valve Co. Ltd.

Sump Pumps.
Saunders Valve Co. Ltd.

Vacuum Pumps.
see Vacuum Pumps.

Railway, *see* Locomotives *and* Track.

Reduction Gears.
David Brown Industries Ltd., General Gear Division.
David Brown Industries Ltd., Radicon Divn.
Maschinenfabrik Buckau R. Wolf A.G.
Crofts (Engineers) Ltd.
Farrel-Birmingham Co. Inc.
William Gardner & Sons (Gloucester) Ltd.
William Kenyon & Sons Ltd.
The Power Plant Co. Ltd.
Progress Engineers Ltd.
Rotary Hoes Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)
John Thompson Ordnance Co.

Refinery Equipment.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Mechans Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stordy Engineering Ltd.
Stork-Werkspoor N.V. (V.M.F.)
Suchar Sales Corporation.
Technoexport Czechoslovakia.

Refractory Bricks.
General Refractories Ltd.
Johns-Manville International Corp.
John G. Stein & Co. Ltd.

Refractory Cement.
General Refractories Ltd.
Johns-Manville International Corp.
Lafarge Aluminous Cement Co. Ltd.
John G. Stein & Co. Ltd.

Refractory Concretes.
General Refractories Ltd.
John G. Stein & Co. Ltd.

Rotary Hoes.
Martin-Markham Ltd.
Rotary Hoes Ltd.

Rubber Belt Cane Carriers.
Farrel-Birmingham Co. Inc.

Saccharimeters and Polarimeters.
Bellingham & Stanley Ltd.
Degenhardt & Co. Ltd.
Ericsson Telephones Ltd.
Hilger & Watts Ltd.
Schmidt & Haensch.
The Sugar Manufacturers' Supply Co. Ltd.
Carl Zeiss Jena.

Sack Closing Machines.
Thomas C. Keay Ltd.
The Sack Filling & Sewing Machine Syndicate Ltd.

Sack Filling Machines.
Brecknell, Dolman & Rogers Ltd.
Librawerk.
Richard Simon & Sons Ltd.

Sack Printing Machines.
Thomas C. Keay Ltd.

Scaffold boards.
Grill Floors Ltd.

Scale Removal and Prevention.
Fisons Pest Control Ltd.
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
The Geigy Company Ltd.
The Kleen-e-ze Brush Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Screens, Centrifugal, *see* Centrifugal Screens.

Screens, Vibrating.
William Boulton Ltd.
Büttner-Werke A.G.
Chain Belt Company.
Cocksedge & Co. Ltd.
Dei-Con Eastern Corporation.
Electromagnets Ltd.
William Gardner & Sons (Gloucester) Ltd.
Gutehoffnungshütte Sterkrade A.G.
Hein, Lehmann & Co. A.G.
International Combustion (Export) Ltd.
Multi-Metal Wire Cloth Co. Inc.
Spencer (Melksham) Ltd.
Duncan Stewart & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Tiss-Metal.
see also Juice Strainers and Screens.

Self-cleaning Strainers.
Ashworth & Parker Ltd.

Ship Loading installations.
Buhler Brothers.
Crone & Taylor (Engineering) Ltd.
Simon Handling Engineers Ltd.

Shredders.
BMA Braunschweigische Maschinenbauanstalt.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gruendler Crusher & Pulverizer Co.
Gutehoffnungshütte Sterkrade A.G.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
Stork-Werkspoor N.V. (V.M.F.)

Silos—Pre-stressed concrete.
A/S De danske Sukkerfabrikker.

Skip Hoists.
Babcock & Wilcox Ltd.
Hugh Campbell (London) Ltd.
Crone & Taylor (Engineering) Ltd.
International Combustion (Export) Ltd.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.
Spencer (Melksham) Ltd.
Strachan & Henshaw Ltd.

Spectrophotometers.
Beckman Instruments Inc.
Degenhardt & Co. Ltd.
Hilger & Watts Ltd.
Carl Zeiss Jena.

Spray Chemicals.
Fisons Pest Control Ltd.

Spray nozzles.
Chain Belt Company.
Dei-Con Eastern Corporation.

Spraying and Dusting Machinery.
Cooper, Pegler & Co. Ltd.

Steam Accumulators.
British Boiler Accessories Ltd.
Cochran & Co., Annan, Ltd.
Duncan Stewart & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Steam Storage Equipment.
see Steam Accumularors.

Steam Superheaters.
Babcock & Wilcox Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
Foster Wheeler Ltd.
John Thompson Water Tube Boilers Ltd.

Steam Traps.
von Arnim'sche Werke G.m.b.H.

Steam Turbines for Mill Drives, etc.
Belliss & Morcom Ltd.
George Cohen, Sons & Co. Ltd.
A. F. Craig & Co. Ltd.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stork Werkspoor N.V. (V.M.F.)

Steel.
George Cohen, Sons & Co. Ltd.

Steel Bar and Wire.
Talbot Stead Tube Co. Ltd.

Steel Flooring and Handrailing.
Grill Floors Ltd.

Stokers—Bagasse Burning Spreader Type.
Babcock & Wilcox Ltd.

Sugar Factory Design and Erection (Cane and Beet).
Honolulu Iron Works Co.
Salzgitter Industriebau G.m.b.H.
Stork-Werkspoor N.V. (V.M.F.)

Sugar Machinery, General.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.

Sugar Machinery, General— *continued*
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
The Squier Corporation.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.).
Technoexport Czechoslovakia.

Sugar Throwers and Trimmers.
Buhler Brothers.
Cocksedge & Co. Ltd.
Crone & Taylor (Engineering) Ltd.
Kingston Industrial Works Ltd.
Spencer (Melksham) Ltd.
Stephens-Adamson Mfg. Co.

Switchgear.
Heemaf N.V.

Temperature Recorders and Controllers.
The British Rototherm Co. Ltd.
Cambridge Instrument Co. Ltd.
Electroflo Meters Co. Ltd.
Evershed & Vignoles Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Controls Ltd.
John Thompson Instrument Co. Ltd.

Thermometers.
The British Rototherm Co. Ltd.
Cambridge Instrument Co. Ltd.
Taylor Controls Ltd.

Track and Track Accessories.
Robert Hudson Ltd.
N.V. Locospoor.
Railway Mine & Plantation Equipment Ltd.
Spoorijzer N.V. Delft.
U.S. Industries Inc. (Great Britain) Ltd.

Tractors.
David Brown Industries, Tractor Divn.

Trailers.
Cary Iron Works.
Martin-Markham Ltd.
Spoorijzer N.V. Delft.
Whitlock Brothers Ltd.

Trench Gratings.
Grill Floors Ltd.

Tubes, Bi-Metal.
Talbot Stead Tube Co. Ltd
Yorkshire Imperial Metals Ltd.

Tubes for Boilers, Evaporators, Juice Heaters, Vacuum Pans, etc.
Babcock & Wilcox Ltd.
Hudson & Wright Ltd.
Kirk & Co. (Tubes) Ltd.
Talbot Stead Tube Co. Ltd.
Yorkshire Imperial Metals Ltd.

Tubes, Carbon, Alloy and Stainless Steel
Kirk & Co. (Tubes) Ltd.
Talbot Stead Tube Co. Ltd.

Tube Cleaners, *see* Scale Removal and Prevention.

Tube Fittings.
A.P.V. Co. Ltd., Industrial Engineering Dept. (*stainless steel*)
Blakey's Boot Protectors Ltd. (*malleable iron*).
Kirk & Co. (Tubes) Ltd. (*malleable iron and stainless steel*)
Talbot Stead Tube Co. Ltd. (*stainless steel*).
Yorkshire Imperial Metals Ltd. (*copper, brass and plastic*).

Tyres.
Firestone International Company.
Firestone Tyre & Rubber Co. Ltd.

Vacuum Pans, *see* **Pans.**

Vacuum Pumps.
Belliss & Morcom Ltd.
Blairs Ltd.
George Cohen, Sons & Co. Ltd.
Comet Pump & Engineering Co Ltd.
Dorr-Oliver Inc., Cane Sugar Divn.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Holden & Brooke Ltd.
International Combustion (Export) Ltd.
The Mirrlees Watson Co. Ltd.
Ateliers Neyret Beylier.

Vacuum Pumps—*continued*
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)
Worthington-Simpson Ltd.

Valves.
A.P.V. Co. Ltd., Industrial Engineering Dept.
von Arnim'sche Werke G.m.b.H.
David Brown Industries Ltd., Foundries Divn.
George Clark & Sons (Hull) Ltd.
George Cohen, Sons & Co. Ltd.
Kirk & Co. (Tubes) Ltd.
The Lunkenheimer Company.
Saunders Valve Co. Ltd.
G. & A. E. Slingsby Ltd.
Talbot Stead Tube Co. Ltd.
Taylor Controls Ltd.

Variable Speed Controls.
Crofts (Engineers) Ltd.
Heenan & Froude Ltd
Duncan Stewart & Co. Ltd.

Vehicle washes.
Grill Floors Ltd.

Water Cooling Towers.
Film Cooling Towers (1925) Ltd.
Foster Wheeler Ltd.
AB. Svenska Fläktfabriken.

Weedkillers.
Fisons Pest Control Ltd.

Weighing Machines.
Adequate Weighers Ltd.
Butz & Leitz G.m.b.H.
Chronos Werk, Reuther & Reisert K.G.
Electroweighers (Birmingham) Ltd.
Fr. Hesser Maschinenfabrik A.G.
Librawerk.
N.V. Servo-Balans.
Richard Simon & Sons Ltd
Stork-Werkspoor N.V. (V.M.F.)
The Sugar Manufacturers' Supply Co. Ltd.
see also Juice Scales.

Wire Cloth.
Ferguson Perforating & Wire Company.
Fontaine & Co.
Multi-Metal Wire Cloth Co. Inc.
Tiss-Metal.

Wrapping machines.
SAPAL.
SIG Swiss Industrial Company.

Yeast Plants.
A.P.V. Co. Ltd., Chemical Engineering Division.
BMA Braunschweigische Maschinenbauanstalt.

BUYERS' GUIDE—ADDRESS LIST

Activated Carbons & Chemicals Ltd.
Burnfield Road, Giffnock, Glasgow, Scotland.
Tel.: Merrylee 2393. *Cable* : Stedmacs, Giffnock.

Adequate Weighers Ltd.,
Bridge Works, Bridge Road, Sutton, Surrey, England.
Tel.: Vigilant 6666/7/8. *Cable* : Adegrate, London.

The A.P.V. Co. Ltd.,
Manor Royal, Crawley, Sussex.
Tel. : Crawley 1360. *Cable* : Anaclastic, Crawley.
Telex : 8737

von Arnim'sche Werke G.m.b.H., Werk Schneider & Helmecke,
Offenbach/Main, Germany.
Tel.: Offenbach 82054.
Cable: Kondenstopf, Offenbach/Main.

Ashworth & Parker Ltd.,
Riverside Works, Bury, Lancs., England.
Tel. : Bury 5125–6. *Cable :* Kinetic, Bury.

Associated Chemical Companies (Sales) Ltd.,
P.O. Box 6, Brotherton House, Westgate, Leeds 1, England.
Tel.: Leeds 29321/8. *Cable :* Aschem, Leeds.
Telex : 55–116.

Babcock & Wilcox Ltd.,
Babcock House, 209 Euston Rd., London, N.W.1, England.
Tel.: Euston 4321. *Cable:* Babcock, London.
Telex: 23256.

W. & R. Balston Ltd.,
see H. Reeve Angel & Co. Ltd.

Andrew Barclay Sons & Co., Ltd.
Caledonia Works, Kilmarnock, Scotland.
Tel.: Kilmarnock 1366/7. *Cable:* Barclayson, Kilmarnock.

Beckman Instruments Inc.
Fullerton, California, U.S.A.
Tel.: Trojan 1–4848. *Cable :* Beckman, Fullerton.
Telex : Fullerton 5210.

Bellingham & Stanley Ltd.,
71 Hornsey Rise, London, N.19, England.
Tel. : Archway 2270. *Cable :* Polyfract, London.

Belliss & Morcom Ltd.,
Ledsam Street Works, Birmingham 16, England.
Tel. : Edgbaston 3531. *Cable :* Belliss, Birmingham 16.

F. W. Berk & Co. Ltd.,
Berk House, 8 Baker Street, London, W.1.
Tel. : Hunter 6688. *Cable :* Berk, London.
Telex: 23796.

Blairs Ltd.,
Glasgow Engineering Works, Woodville Street, Govan, Glasgow, S.W.1, Scotland.
Tel. : Govan 1261 *Cable :* Blazon, Glasgow.

Blakey's Boot Protectors Ltd.,
see Pennine Chainbelt Co. Ltd.

BMA Braunschweigische Maschinenbauanstalt,
(20b) Braunschweig, Bahnhofstrasse 5, Germany.
Tel. : Braunschweig 23691. *Cable :* Bema, Braunschweig
Telex : Bema Bswg. 0952840

William Boulton Ltd.,
Providence Engineering Works, Burslem, Staffs., England.
Tel.: Stoke-on-Trent 88661. *Cable:* Boultons, Burslem.

Brecknell, Dolman & Rogers Ltd.,
Pennywell Road, Bristol 5, England.
Tel.: Bristol 58222. *Cable:* Bremaners, Bristol.

British Boiler Accessories Ltd.
62/63 Fenchurch Street, London E.C.3., England.
Tel.: Royal 4122/6305. *Cable :* Boileracs, London.

The British Rototherm Co. Ltd.,
Merton Abbey, London S.W.19, England.
Tel.: Liberty 7661. *Cable:* Rototherm, London.

Thomas Broadbent & Sons Ltd.,
Central Ironworks, Huddersfield, England.
Tel : Huddersfield 5520. *Cable :* Broadbent, Huddersfield.

Broussard Machine Company,
see Logan Perkins.

David Brown Corporation (Sales) Ltd.,
96/97 Piccadilly, London, W.1, England.
Tel. : Grosvenor 5271. *Cable :* Davibron, London

David Brown Industries Ltd., Coventry Gear Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., Foundries Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., General Gear Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., Jackson Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., Radicon Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., Tractor Division,
see David Brown Corporation (Sales) Ltd.

Maschinenfabrik Buckau R. Wolf A.G.,
Grevenbroich/Ndrrh., Germany.
Tel. : Grevenbroich 1481.
Cable : Maschinenbau, Grevenbroich.
Telex : 08517111.

Buell Ltd.,
3 St. James's Square, London, S.W.1, England.
Tel. : Trafalgar 2528. *Cable :* Allentare, London.

Buhler Brothers,
Uzwil, Switzerland.
Tel.: 5 62 12 Uzwil *Cable :* Buhler, Uzwil.
Telex : 57202

Büttner-Werke A.G.,
Postfach 59, Krefeld-Uerdingen 1, Germany.
Tel.: Krefeld 43511. *Cable:* Büttner, Krefeld-Uerdingen.

Buttner Works Inc.
52 Vanderbilt Avenue, New York 17, N.Y., U.S.A.
Tel.: Murray Hill 9–5098. *Cable :* Buttnerusa, New York.

Buttner Works (Canada) Ltd.,
P.O. Box 688, Montreal, Quebec, Canada.
Tel.: RE-7-9053 *Cable :* Buttner, Montreal.

Butz & Leitz G.m.b.H.,
(22b) Ludwigshafen a. Rh., Industriestrasse, Germany.
Tel.: Ludwigshafen 63618/9, 64003.
Cable : Butzleitz, Ludwigshafenrhein.

Cambridge Instrument Co. Ltd.,
13 Grosvenor Place, London S.W.1., England.
Tel.: Belgravia 5066. *Cable :* Unipivot, London.

Hugh Campbell (London) Ltd.,
Kent House Lane, Beckenham, Kent, England.
Tel.: Sydenham 8178, 8238. *Cable:* Mechandle, Beckenham.

The Cape Asbestos Co. Ltd.,
114 & 116 Park Street, London, W.1., England.
Tel.: Grosvenor 6022. *Cable:* Incorrupt, London.

Cary Iron Works,
see Logan Perkins.

Catchpole Engineering Co. Ltd.,
Bury St. Edmunds, Suffolk, England.
Tel.: Bury St. Edmunds 2591.
Cable: Beslift, Bury St. Edmunds.

Cellulose Development Corporation Ltd.,
Hatch End, Middlesex.
Tel.: Hatch End 2261. *Cable :* Celdecor, Pinner.

Chain Belt Company,
4701 West Greenfield Avenue, Milwaukee 1, Wisconsin, U.S.A.
Tel.: Evergreen 4–3000. *Cable:* Beltchain, Milwaukee.

Chambon Ltd.,
Riverside Works, Standish Road, London W.6., England.
Tel.: Riverside 6086. *Cable:* Chambonted, London.

Choquenet L. Fonderies et Ateliers—Sté. Ame,
Chauny (Aisne), France.
Tel. Chauny 34.

Chronos Werk, Reuther & Reisert K.G.,
Hennef-Sieg (Rhld), Germany.
Tel.: Sa. Nr. 2381/83. *Cable :* Chronos, Hennefsieg.
Telex : 8/869224

George Clark & Sons (Hull) Ltd.,
Hawthorn Avenue, Hull, England.
Tel.: Hull 37654. *Cable:* Clark, Hull.

The Clydesdale Chemical Co. Ltd.,
105 Millerston Street, Glasgow, E.1, Scotland.
Tel. : Bridgeton 4374. *Cable :* Cactus, Glasgow

Cochran & Co., Annan, Ltd.,
Annan, Dumfriesshire, Scotland.
Tel : Annan 111. *Cable* : Multitube, Annan.

Cocksedge & Co. Ltd.,
Grey Friars Road, Ipswich, Suffolk, England.
Tel.: Ipswich 56161. *Cable:* Cocksedge, Ipswich.

George Cohen, Sons & Co. Ltd.,
58 Wood Lane, London, W.12, England.
Tel. : Shepherds Bush 2070. *Cable :* Omniplant, London.
Telex : 21288/9.

Comet Pump & Engineering Co. Ltd.,
Johnson Road, West Croydon, Surrey, England.
Tel. : Thornton Heath 3816. *Cable :* Comet, Croydon.

Cooper, Pegler & Co. Ltd.,
P.O. Box 9–98, Burgess Hill, Sussex, England.
Tel.: Burgess Hill 2525. *Cable :* Stomata, Burgess Hill.

Cotton Bros. (Longton) Ltd.,
Crown Works, Portland Road, Longton, Stoke-on-Trent, Staffs., England.
Tel.: Longton 33021. *Cable:* Cotbro, Stoke-on-Trent.

A. F. Craig & Co. Ltd.,
Caledonia Engineering Works, Paisley, Scotland.
Tel. : Paisley 2191. *Cable :* Craig, Paisley.

Crofts (Engineers) Ltd.,
Thornbury, Bradford 3, Yorkshire, England.
Tel. : Bradford 65251. *Cable :* Crofters, Bradford.
Telex : 51186.

Crone & Taylor (Engineering) Ltd.,
Sutton Oak, St. Helens, Lancs., England.
Tel.: St. Helens 3283/5 *Cable:* Crontaylor, St. Helens.

James A. Cuthbertson Ltd.,
Station Road, Biggar, Lanarkshire, Scotland.
Tel.: Biggar 20. *Cable:* Mechadrain, Biggar.

C.Z. Scientific Instruments Ltd.,
12a Golden Square, London W.1., England.
Tel.: Gerrard 4488 *Cable:* Cezet, London.

Dallow, Lambert & Co. Ltd.,
Thurmaston, Leicester, England.
Tel.: Syston 3333. *Cable:* Dust, Leicester.

Davey, Paxman & Co. Ltd.,
Standard Iron Works, Colchester, Essex, England.
Tel. : Colchester 5151. *Cable :* Paxman, Colchester.
Telex : 1875.

A/S De danske Sukkerfabrikker,
Langebrogade 5, Kobenhavn K.
Tel.: Central 9030. *Cable:* Sukkerfabrikker, Copenhagen.
Telex : 5530 Sukker KH.

Degenhardt & Co. Ltd.,
6 Cavendish Square, London W.1., England.
Tel.: Langham 6097/9.

Dei-Con Eastern Corporation,
Eastern Hemisphere Export Sales Divn., The Deister Concentrator Co. Inc.,
60 Beaver St., New York 4, N.Y., U.S.A.
Tel.: Digby 4–7389. *Cable :* Retsied, New York.

Dicalite Department, Great Lakes Carbon Corp.,
18 East 48th Street, New York 17, N.Y., U.S.A.
Tel. : Eldorado 5–6200. *Cable :* Dicalite, New York.

Dorr-Oliver Inc., Cane Sugar Division,
Stamford, Conn., U.S.A.

The Drewry Car Co. Ltd.,
City Wall House, 129/139 Finsbury Pavement, London E.C.2, England.
Tel.: Monarch 0671. *Cable :* Inneal, London.
Telex : London 25331

Dunford & Elliott Process Engineering Ltd.,
Linford Street, London, S.W.8, England.
Tel. : Macaulay 2405. *Cable :* Lindaresco, London.

Duper Water Conditioning Company,
Nieuwendammerkade 1–7, Amsterdam-Noord, Holland.
Tel.: 020–60821. *Cable :* Waterduper/Amsterdam.
Telex : 14278.

Edwards Engineering Corp.,
715 Camp Street, New Orleans 12, La., U.S.A.
Tel. : Tulane 0175. *Cable :* Joedco, New Orleans.

Eimco (Great Britain) Ltd.,
Earlsway, Team Valley, Gateshead 11, England.
Tel. : Low Fell 7–7241. *Cable :* Eimco, Gateshead.

Electroflo Meters Co. Ltd.,
Abbey Road, Park Royal, London, N.W.10, England.
Tel.: Elgar 7641/8. *Cable:* Elflometa, London.
Telex: 2–3196.

Electromagnets Ltd.,
Boxmag Works, Bond St., Hockley, Birmingham, England.
Tel.: Central 5391–3. *Cable:* Boxmag, Birmingham.

Electroweighers (Birmingham) Ltd.,
Moseley St., Birmingham 12, England.
Tel.: Victoria 2223 *Cable.:* Elecweigh, Birmingham.

Ericsson Telephones Ltd., Instrument Division,
High Church St., New Basford, Nottingham, England.
Tel.: Nottingham 75115. *Cable:* Ericsson, Nottingham

Escher Wyss Ltd.,
Terminal House, 52 Grosvenor Gardens, London, S.W.1, England.
Tel. : Sloane 8101. *Cable :* Escherwyss, London.

Evershed & Vignoles Ltd.,
Chiswick, London, W.4, England.
Tel. : Chiswick 3670. *Cable :* Megger, London.
Telex : 22–583.

Ewart Chainbelt Co. Ltd.,
Colombo Street, Derby, England.
Tel.: Derby 45451. *Cable:* Chainbelt, Derby.

Extraction Continue De Smet S.A.,
38, Avenue de France, Anvers, Belgium.
Tel.: 32.43.05; 32.43.15. *Cable:* Extraxsmet, Anvers.

Farnell Carbons Ltd.,
Conduit Road, Plumstead, London, S.E.18, England.
Tel: Woolwich 1158. *Cable:* Scofar, London.

Farrel-Birmingham Co. Inc.,
Ansonia, Conn., U.S.A.
Tel.: Regent 4–3331.

Farrow & Sons Ltd.,
Spalding, Lincs., England.
Tel.: Spalding 3388. *Cable:* Farrows, Spalding.

Ferguson Perforating & Wire Co.,
130–140 Ernest Street, Providence, R.I., U.S.A.
Tel.: Williams 1–8876. *Cable:* Ferguson, Providence

Film Cooling Towers (1925) Ltd.,
Chancery House, Parkshot, Richmond, Surrey, England.
Tel.: Richmond 6494/8. *Cable:* Aloof, Richmond.

Filtres Philippe S.A.,
P.O. Box 30, 109 Bld. Henri-Barbusse, Houilles (S. & O.), France.
Tel.: 961-79-90. *Cable:* Alfilipe, Houilles.

Firestone International Company,
1200 Firestone Parkway, Akron, Ohio, U.S.A.
Tel.: Hemlock 4-1671 *Cable:* Firestone, Akron.

Firestone Tyre & Rubber Co. Ltd.,
Brentford, Middlesex.
Tel.: ISLeworth 4141. *Cable:* Firestone, Brentford.

Fischer & Porter Ltd.,
Salterbeck Trading Estate, Workington, Cumberland.
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Telex: 31307.

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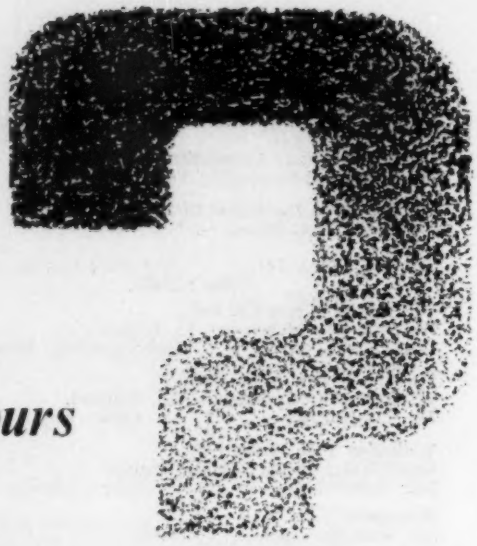

is yours a

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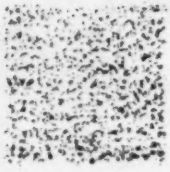
problem



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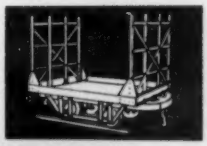
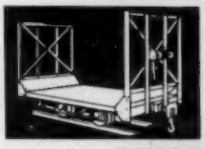
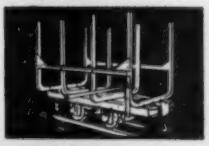


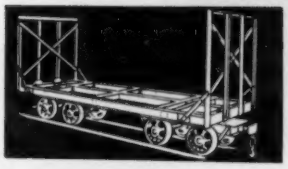
1 ton car.



3 ton car.



5 ton car for end loading.



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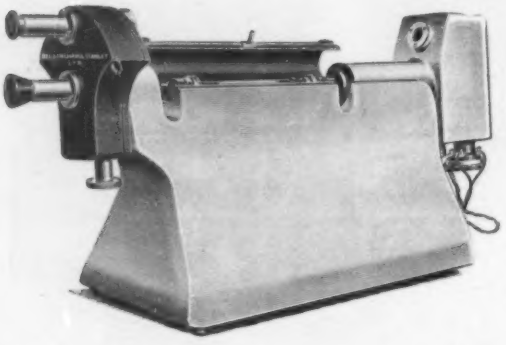

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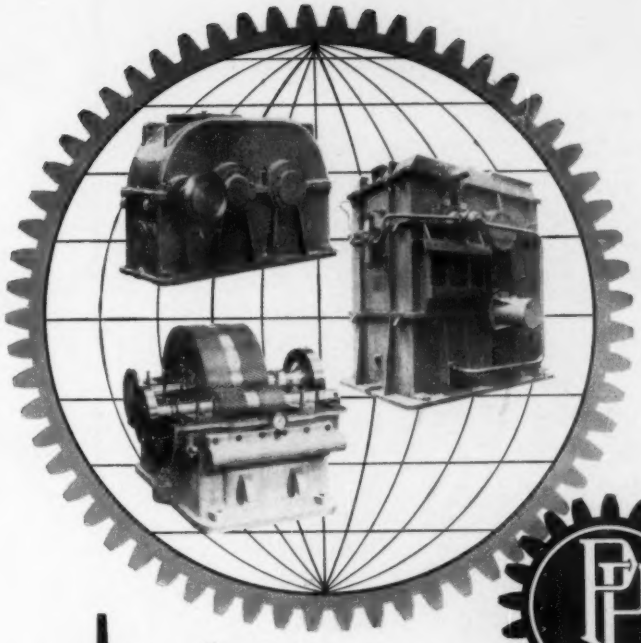

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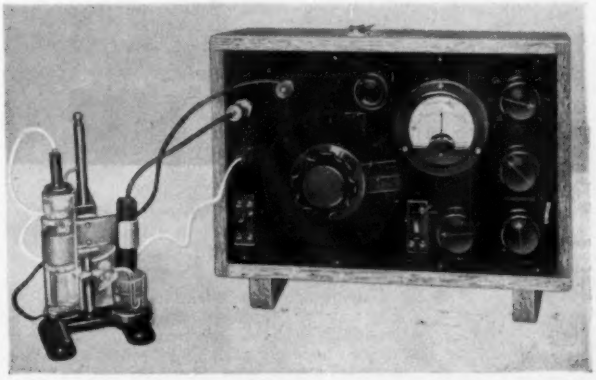

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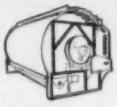
KHUZESTAN FACTORY, IRAN, INSTALLS DORR-OLIVER EQUIPMENT. DORR-OLIVER, N. V. HOLLAND, COOPERATING WITH STORK-WERKSPOOR, CONTRACTOR, FURNISHES 2 RAPIDORR CLARIFIERS,  3 OLIVER-CAMPBELL FILTERS.

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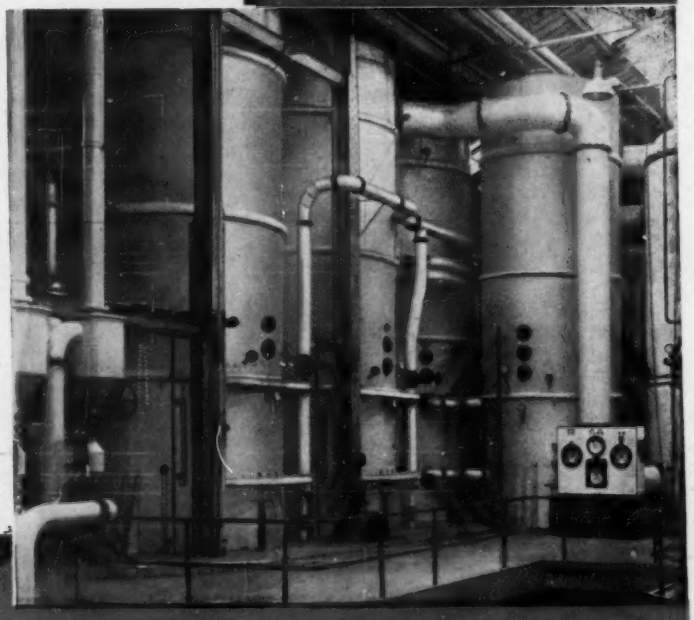

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